Vol. 34 APRIL, 1941 No. 4
Published in two sections—Part 1

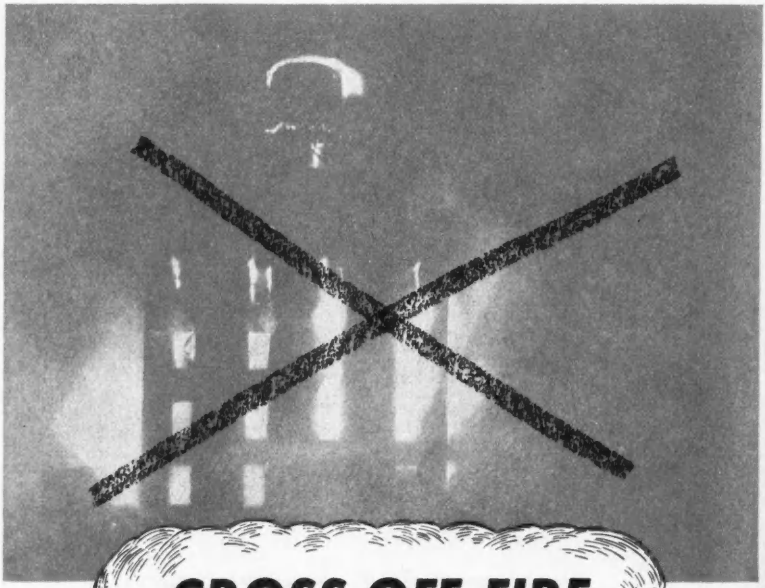
QUARTERLY
OF THE

NATIONAL FIRE PROTECTION ASSOCIATION

"To Promote the Science and Improve the Methods of Fire Protection and Prevention."

PUBLISHED QUARTERLY AT BOSTON, MASS., BY THE
NATIONAL FIRE PROTECTION ASSOCIATION

Printed in U. S. A.



CROSS OFF FIRE

As The Most Serious Threat to Property and Production

CARDOX

The NON-DAMAGING Fire Extinguishing System

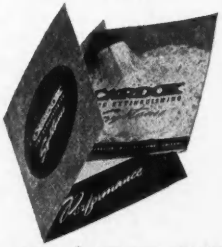
● Taming fire—the constant goal of fire fighters and fire prevention agencies—now is carried far beyond previous limits with Cardox Fire Extinguishing Systems. These Systems utilize the recognized characteristics of carbon dioxide as an extinguishing medium—its swiftness, sureness, and non-damaging qualities. But Cardox extends the useful range of CO_2 to cover virtually any hazard at any location through bulk storage capacity and tremendous rates of emission.

How this unique degree of protection is achieved and secured . . . the adaptability of Cardox to special hazards . . . how it overwhelms even the most stubborn fires with astonishing speed . . . these are a few of the points covered in the Cardox Data File. Send for it today.

Secure this

DATA FILE

Including Underwriters' Laboratories Approval Reports on Cardox Manual, Automatic and Automatic Manual Systems.



CARDOX CORPORATION

BELL BUILDING · CHICAGO, ILLINOIS

Vol. 34 April, 1941 No. 4

QUARTERLY

OF THE

National Fire Protection Association

Subscriptions to the QUARTERLY are accepted only as a part of the general publications of the Association which are sent to members. Associate membership is open to anyone interested; annual dues $10.

Entered as second-class matter December 15, 1923, at the Post Office at Boston, Mass., under act of March 3, 1879.

60 BATTERYMARCH STREET, BOSTON, MASS.

National Fire Protection Association

INTERNATIONAL

A NON-PROFIT TECHNICAL AND EDUCATIONAL ORGANIZATION

To promote the science and improve the methods of fire protection and prevention.

Officers

ALVAH SMALL, PRESIDENT
DAVID J. PRICE, VICE-PRESIDENT
RICHARD E. VERNOR, VICE-PRESIDENT
HOVEY T. FREEMAN, SECRETARY-TREASURER

ALBERT T. BELL, CHAIRMAN BOARD OF DIRECTORS
PERCY BUGBEE, GENERAL MANAGER
ROBERT S. MOULTON, TECHNICAL SECRETARY
HORATIO BOND, CHIEF ENGINEER

Organization Members

American Institute of Architects.
American Institute of Electrical Engineers.
Air Conditioning & Refrigerating Machinery Association.
American Association of Port Authorities.
American Boiler Manufacturers Association and Affiliated Industries.
American Gas Association.
American Hotel Association.
American Marine Insurance Syndicates.
American Petroleum Institute
American Transit Association.
American Water Works Association.
American Wood-Preservers' Association.
Arizona Equitable Rating Office.
Arkansas Fire Prevention Bureau.
Asbestos Cement Products Association.
Asphalt Roofing Industry Bureau.
Associated Factory Mutual Fire Insurance Co's., Inspection Department.
Associated Lumber Mutual Fire Insurance Companies.
Association of Canadian Fire Marshals.
Association of Edison Illuminating Companies.
Association of Fire Underwriters of Baltimore City.
Association of Mill and Elevator Mutual Insurance Companies.
Association of Mutual Fire Insurance Engineers.
Board of Fire Underwriters of the Pacific.
Board of Underwriters of the Territory of Hawaii.
Board of Underwriters of New York.
Boston Board of Fire Underwriters, Inc.
British Columbia Underwriters Association.
Bureau of Explosives.
Canadian Automatic Sprinkler Association.
Canadian Manufacturers' Association.
Canadian Underwriters' Association.
Cast Iron Pipe Research Association.
Cellulose Plastics Manufacturers' Association.
Central Station Fire Protection Association.
Central Traction and Lighting Bureau.
Chemical Fire Extinguisher Association, Inc.
Chicago Board of Underwriters.
Chlorine Institute, Inc.
Clay Products Association.
Compressed Gas Manufacturers' Association.
Cork Institute of America.
Cotton Insurance Association.
Dominion Board of Insurance Underwriters.
Eastern Underwriters Association.
Eastern Underwriters Inspection Bureau.
Edison Electric Institute.
Factory Insurance Association.
Factory Mutual Laboratories.
Federation of Mutual Fire Insurance Companies.
Fire Insurance Rating Bureau (Wis.).
Fire Protection and Insurance Section of the Association of American Railroads.
Fire Underwriters Inspection Bureau (Minn., N. D., S. D.).
Idaho Surveying and Rating Bureau.
Illinois Inspection Bureau.
Improved Risk Mutuals.
Indiana Inspection Bureau.
Institute of Makers of Explosives.
Insurance Association of Providence.
International Acetylene Association.
International Association of Electrical Inspectors.
International Association of Fire Fighters.
International Brotherhood of Electrical Workers.
Iowa Insurance Service Bureau.
Kansas Inspection Bureau.
Kentucky Actuarial Bureau.
Liquefied Petroleum Gas Association, Inc.
Louisiana Rating and Fire Prevention Bureau.
Manufacturing Chemists' Association of the United States.
Michigan Inspection Bureau.
Middle Department Rating Association.
Mississippi State Rating Bureau.
Missouri Inspection Bureau.
Motion Picture Producers and Distributors of America, Inc.
Motor Fire Apparatus Manufacturers' Association, Inc.
Mountain States Inspection Bureau.
Mutual Fire Inspection Bureau of New England.
Mutual Fire Insurance Association of New England.
National Association of Air Filter Manufacturers.
National Association of Credit Men.
National Association of Dyers and Cleaners.
National Association of Engine and Boat Manufacturers, Inc.
National Association of Fan Manufacturers.
National Association of Insurance Agents.
National Association of Mutual Insurance Companies.
National Automatic Sprinkler Association.
National Board of Fire Underwriters.
National Clean Up and Paint Up Campaign Bureau.
National Electrical Contractors Association.
National Electrical Manufacturers' Association.
National Lightning Protection Association.
National Lumber Manufacturers' Association.
National Paint, Varnish and Lacquer Association, Inc.
Nebraska Inspection Bureau.
New Brunswick Board of Fire Underwriters.
New England Fire Insurance Rating Association.
Newfoundland Board of Fire Underwriters.
New Hampshire Board of Underwriters.
New Jersey Schedule Rating Office.
New York Board of Fire Underwriters.
New York Fire Insurance Rating Organization.
Nova Scotia Board of Insurance Underwriters.
Ohio Inspection Bureau.
Oil Burner Institute, Inc.
Oil Insurance Association.
Oklahoma Inspection Bureau.
Oregon Insurance Rating Bureau.
Pacific Coast Building Officials' Conference.
Pacific Factory Insurance Association.
Railroad Insurance Association.
Red Cedar Shingle Bureau.
Safe Manufacturers National Association.
Society of Motion Picture Engineers.
South-Eastern Underwriters' Association.
The Sprinkler Leakage Conference.
Tennessee Inspection Bureau.
Terminal Elevator Grain Merchants' Association.
Texas Board of Insurance Commissioners.
Texas Inspection Bureau.
Underwriters' Association of the District of Columbia.
Underwriters' Laboratories, Inc.
Underwriters Rating Board (Albany, N. Y.).
Underwriters Service Association.
United States Conference of Mayors.
Virginia Insurance Rating Bureau.
Washington Surveying and Rating Bureau.
Western Actuarial Bureau (Fire).
Western Canada Insurance Underwriters' Association.
Western Factory Insurance Association.
Western Sprinkled Risk Association.
Western Underwriters Association.
West Virginia Fire Underwriters' Association.
West Virginia Inspection Bureau.

Table of Contents.

FIRE IN A DEFENSE PLANT ..... FRONTISPIECE

EDITORIALS 293

MEETING OF THE BOARD OF DIRECTORS 299

OUT OF THE BLACKOUT, *John A. West, Jr.* 302

CHICAGO FIRE PREVENTION EXHIBIT 331

FIRE RECORD OF CITIES, 1940 332

TYPE "S" FUSES 344

BROCKTON THEATRE TRAGEDY, *Warren Y. Kimball* 348

THE NEW ORLEANS WAREHOUSE FIRE, *H. P. Dixey and W. J. Moll* 352

THE NEW HAVEN QUILT AND PAD CO. FIRE, *Robert S. Moulton* 357

AIRPLANE HANGAR FIRE RECORD 363

MAGNESIUM AND ITS ALLOYS, *H. S. Hirst and A. B. Guise* 374

FIRES IN WHICH THERE WAS LOSS OF LIFE 389

INDEX VOLUME THIRTY-FOUR 394

Reports of fires appearing in the Quarterly are copies of or extracts from written reports forwarded to the Association. This Association, as a body, is not responsible for the statements or opinions of any of its members.

International.

Seven men were burned to death and several seriously injured in this New York city (Brooklyn) fire on January 14. The plant was making wooden locker trunks on a contract for the U. S. Army. The building was of ordinary frame construction. Paint spraying was done without benefit of automatic sprinkler protection or properly ventilated fire-resistive enclosure for the spraying operation. Data are lacking as to exit arrangements, but the extent of the fatalities would indicate that exits were inadequate for such a hazardous occupancy. The fire occurred on a cold morning when two five-gallon buckets of paint were placed over a kerosene stove. A fire extinguisher brought up by an employee was inoperative, presumably frozen.

The Quarterly

Vol. 34 April, 1941 No. 4

The Toronto Meeting. The 45th annual meeting to be held in Toronto, May 12 to 16, will be another important landmark in the annals of the Association. Members who attended the 1931 meeting in Toronto retain most pleasant memories of the hospitality of our Canadian hosts. All who go to Toronto this year are assured of the warmest welcome. With some ten per cent of our membership in the Dominion, it seems proper that we should meet in a Canadian city about once in ten years. Under war time restrictions, our Canadian members would have difficulty in traveling to the states, but American travel to Canada is welcomed by the Dominion government. The favorable exchange reduces the expense to members from the States, and all American expenditures in Canada contribute indirectly toward Canada's war efforts. Both the technical and popular features of the program this year will be of unusual interest and value. Our 1931 annual meeting in Toronto showed a larger registration than any previous meeting in the history of the Association and the 1941 meeting should be similarly popular.

* * * * *

The 1941 Advance Reports. Part 2 of this QUARTERLY includes the various technical committee reports preprinted for presentation to the 1941 annual meeting in Toronto. This new volume takes the place of the separate publication of individual committee reports which has been in effect in previous years. The previous practice has been to announce the titles of these reports in a list sent to members with the April NEWS LETTER and to supply copies to individual associate members only upon specific request. The present plan of circulating all preprinted technical committee reports to all members in advance of the annual meeting gives everyone advance notice of the action proposed on the various subjects so that all may have opportunity to register their comments and be prepared to participate in the discussions. It is hoped that this new plan will be generally welcomed by members as a desirable service.

Under this plan, the texts of these reports will not be repeated in the Proceedings, which will contain only the record of the discussion and action. Repetition of these reports in the Proceedings would be an unnecessary duplication, as the needs of the members seem adequately served by having the texts

A fire extinguisher brought up by an employee was inoperative, presumably frozen.

of the advance reports in a single volume suitable for present reference and permanent record. This change will not affect in any way the present policy of final publication of the various standards in pamphlet form available to all N.F.P.A. members.

* * * * *

Fireworks Law Campaign. The campaign for the model fireworks law, conducted jointly by the Fire Marshals Section, the Pyrotechnics Committee, and the Executive Office of the N.F.P.A., is making very substantial progress and has aroused an amazing amount of popular support. A substantial proportion of the population of the United States is now free from the dread of the celebration of Independence Day which so many parents have experienced.

The first states to adopt good fireworks legislation permitting public displays under competent supervision, but prohibiting promiscuous sale and use of fireworks were Michigan, Iowa and New Jersey. The N.F.P.A. model fireworks law was based on the legislation in those states. In 1939 the model law was adopted in Pennsylvania, Delaware, Utah, Indiana and West Virginia, and in 1940 the great state of New York adopted the measure.

This year nearly a score of states had the bill introduced. Ohio passed the bill in March. More recently, Arizona, Maryland and Minnesota have adopted the law, making a total of 13 states which have taken this action. The measure was defeated early in the year in Kansas, Nebraska, Montana and North Carolina, but on the first of April was still being considered in Connecticut, Illinois, Maine, Massachusetts, Missouri, New Hampshire, North Dakota and Wisconsin.

One of the most satisfactory aspects of the campaign has been the support that has been forthcoming from a variety of very important groups. Active support and coöperation for specific bills in various states have come from such organizations as the American Medical Association, the General Federation of Women's Clubs, the National Council of Parent Teacher Organizations, the National Society for the Prevention of Blindness, the Council of State Governments, the United States Chamber of Commerce, the United States Junior Chamber of Commerce, the International Association of Fire Chiefs, the International Association of Fire Fighters, the National Association of Insurance Agents, and the United States War Department. This is an impressive array. The prime movers in getting legislation introduced in various states have been from many groups. In California the fight for the bill, only partially successful, was led by the State Junior Chamber of Commerce organization. When the Florida Legislature convenes, the bill will be presented largely through the energy of a Miami police captain. In Massachusetts the bill was sponsored by the Boston Fire Commissioner, and in Maryland by the Maryland Society for the Prevention of Blindness. In Minnesota the bill was initiated by the

League of Municipalities, in Missouri by the St. Louis Safety Council and the state medical association. The insurance rating bureaus have played a prominent part in getting the bill introduced in Arizona, Kansas and New Hampshire.

An interesting outline of the main arguments put forth in the various legislatures against the adoption of the fireworks law was recently printed in the Baltimore *Evening Sun* in an article by John Williams Avirett, 2nd, President of the Maryland Society for the Prevention of Blindness. Mr. Avirett summed up these arguments as follows:

1. Fireworks legislation is unpatriotic.
2. Fireworks are fun, why deprive the children of fun?
3. Roller skates and bicycles cause more injuries to children than fireworks — why not ban them?
4. Proponents of the bill are fanatics and reformers.
5. Provisions of the bill are too strict. Less strict provisions would do just as well.
6. The adoption of the bill would shut down the fireworks factories and throw people out of work.
7. Adoption of the bill would deprive wholesalers and retailers of profits.

It can be readily shown that all of these arguments are specious and not very convincing when the tremendous amount of suffering from the promiscuous sale and use of fireworks is thrown in the balance.

* * * * *

Fire Defense. Because of the widespread demand for information on incendiary bombs, sabotage, civil defense organization and protection of industries producing essential materials for the army and navy, the Executive Office prepared and distributed to all N.F.P.A. members on March 15 the book, "Fire Defense."

In addition to the N.F.P.A. membership, copies of the book were sent to the President of the United States, principal Cabinet officers, members of the National Advisory Defense Commission, the 48 governors, the state leagues of municipalities, and other agencies and individuals concerned with the defense program.

That the material presented in this book was timely has already been evidenced by a large volume of congratulatory letters received from practically all of the agencies and individuals to whom complimentary copies were sent. The comments, if all were to be printed, would fill this QUARTERLY, but we quote from a few typical reactions herewith.

Secretary of War Stimson says:

"The comprehensive approach to this serious problem as evidenced by your book is most interesting. I am referring it to the branch of the War Department most vitally interested in civil defense for its information and reference."

James R. Coxen of the United States Office of Education says:

"I wish to congratulate you on the very excellent material which this book contains. I feel it will be very useful in explaining the necessity for an expansion of existing fire protection facilities to meet emergency needs."

From Milo J. Warner, National Commander of the American Legion, came the following comment:

"I find the book excellently done and very informative. Due to the fact that the 11,800 posts of the American Legion will play an important part in the home defenses of this nation, we may be interested in securing copies of this book in quantity lots for future use."

Eliot Ness, Director of Public Safety of the City of Cleveland, says:

"'Fire Defense' contains the answers to a great many questions I have been endeavoring to answer and I know it will be very helpful to me."

Congressman Clifford Davis of Tennessee says:

"Nothing could be more to the point right at this moment and certainly it behooves all of us to learn something of this subject even though we all pray that this thing may not be brought to our continent. With congratulations for being abreast if not ahead of the times."

Professor Zanetti of the Department of Chemistry of Columbia University writes as follows:

"Many thanks indeed for the most interesting and complete compilation of fire defense that I have seen. It constitutes a most valuable and timely document, one that should be printed to the millions of copies and widely distributed to focus attention on this most important problem. I have been harping and lecturing on this subject for over ten years and it is a great satisfaction to me to see the matter being taken seriously by such a powerful agency as your association."

The Hon. Paul V. McNutt, Federal Security Administrator, comments as follows:

"I am happy to have this publication and appreciate your thoughtfulness in sending it. The National Fire Protection Association is to be commended for their desire to be of assistance in the important task confronting our nation."

Richard W. Thrush of the American Red Cross says:

"This is an exceedingly interesting and valuable compilation and certainly represents a great deal of careful planning and well-directed effort."

Tom A. Burke, Executive Vice-President of the Greater New York Safety Council, says:

"Your 'Fire Defense' is a splendid contribution. Let me extend my congratulations on a perfectly grand piece of work."

Typical of the reaction of the governors is the following comment from George L. Burr, Executive Secretary of the State Defense Council of Florida:

"Governor Holland has forwarded to this office a copy of your new book on Fire Defense, which is the most comprehensive thing of the kind that has come to the attention of our organization We are hoping it will be possible to secure a number of additional copies for distribution to our councils in each county."

* * * * *

Magnesium. Magnesium and magnesium alloys are being used to an increasing extent in airplane parts and for other defense manufacturing. The production of magnesium is being greatly increased to meet defense needs, with an output that is expected to reach an annual rate of about

1,000,000 pounds by the end of the year, as compared with an output of only about a tenth of this last year. Owing to the ready combustibility of this metal, the difficulty of extinguishing fires in it by ordinary means, and the considerable current extension in the use and handling of magnesium in industrial plants that have not had previous experience with it, the editors of the QUARTERLY are deviating from precedent and are reprinting in this issue in revised form the article on "Magnesium and Its Alloys," first published in the October, 1940, QUARTERLY.

The authors, members H. S. Hirst and A. B. Guise of the Factory Mutual Laboratories, report that in the six months since the publication of the October QUARTERLY, there have been so many new developments in the use and processing of magnesium that they have found it necessary to make extensive changes in the original text to bring it up to date. A further reason for republication is that the demand for copies of the October issue of the QUARTERLY is such that the entire edition was exhausted and copies are no longer available.

An item of major importance in this revised article is the reference to a new compound which has been developed for extinguishing magnesium fires. It has previously been reported that water and other common extinguishing agents are ineffective on magnesium fires in industry, though it is true the spray of water has been found to be the most practicable method of handling small incendiary bombs in England. In that case, however, the action of the water is to accelerate the combustion of the magnesium, thus disposing of the bomb more quickly and at the same time wetting and cooling the surroundings to prevent the spread of fire. Sand and various powdered materials have been recommended for handling magnesium fires, but none has been found completely satisfactory and effective. The new extinguishing powder mentioned in the article in this QUARTERLY has been developed by the principal manufacturer of magnesium in the United States in apparent recognition of the responsibility of the manufacturer of a product to provide appropriate means for safeguarding its hazards.

* * * * *

N.B.F.U. 75 Years. The National Board of Fire Underwriters is this year marking the observance of the 75th anniversary of the founding of the Board. The observance will culminate in a two-day annual meeting to be held on May 27 and 28 in New York.

There are few N.F.P.A. members who do not know about and appreciate the work of the National Board of Fire Underwriters. The membership of the Board is made up of most of the stock fire insurance companies of the country and while theoretically the service of the Board is for its membership, many of the aspects of the work of the organization are along the lines of public service in the prevention and control of the fire waste.

The work of the National Board of Fire Underwriters is carried on under the direction of committees of company executives, among these being the Committees on Fire Prevention and Engineering Standards, Construction of Buildings, Incendiarism and Arson, and Statistics and Origin of Fires.

For all of its own 45 years, the N.F.P.A. has had close contact with the work and the staff of the National Board of Fire Underwriters. Many and valued have been the contributions of the National Board staff to N.F.P.A. work. General Manager W. E. Mallalieu of the National Board has served as President of the National Fire Protection Association and is still an active member of the Board of Directors. The services on N.F.P.A. technical committees given by Chief Engineer George W. Booth and Engineers Newell, Goldsmith, Hutson, Swan, and Fowler, to name only a few, have been invaluable. Likewise every N.F.P.A. member recognizes the contribution of T. Alfred Fleming of the National Board's staff as Chairman of the N.F.P.A. Committee on Fire Prevention and Clean-up Campaign for many years.

We are glad to pay tribute to the National Board of Fire Underwriters on the occasion of its 75th anniversary. May it continue its constructive contributions to society for many, many years to come!

Meeting of Board of Directors.

Atlantic City, January 18, 1941.

Present.

Albert T. Bell, Chairman
Alvah Small, President
David J. Price, Vice-President
Richard E. Vernor, Vice-President
Hovey T. Freeman, Secretary-Treasurer
George W. Elliott, Past President

A. L. Brown
H. T. Cartlidge
C. C. Johnson
C. W. Johnson
Arthur H. Kehoe
W. E. Mallalieu
Harold L. Miner
C. W. Pierce
W. J. Scott

There were also present Percy Bugbee, General Manager; Robert S. Moulton, Technical Secretary, and Horatio Bond, Chief Engineer.

Business Transacted.

1. It was voted to hold the 1941 annual meeting in Toronto the week of May 12. Suggestions for the program were discussed and referred to the Program Committee.

2. Various aspects of fire protection as a vitally important factor in national defense were discussed, and the Executive Office was authorized in the name of the Association to concentrate its attention upon the problems in-

volved, to secure all available information on the subject, to direct all available facilities toward the effective coördination of fire defense activities, calling upon members for such coöperation and assistance as may be needed, to proceed with measures for advancing fire defense as opportunities for service may appear, developing plans and programs for such further activities as may appear desirable and reporting thereon at the next meeting of the Board.

3. Verbal reports were rendered by Messrs. Bugbee, Moulton and Bond on Membership, Publications, Advertising, Field Service, the Fire Marshals Section, the Volunteer Firemen's Section, and the cigarette hazard campaign.

4. A proposal for exhibits at N.F.P.A. annual meetings was tabled.

5. It was voted to establish an endowment fund plan to facilitate bequests to the Association.

6. The report of the Committee on Technical Committee Procedure was adopted, including action on the following:

Scope statements for the Committees on Finishing Processes, on Museums, Art Objects and Historic Buildings, on Ovens and Furnaces, and on Special Extinguishing Systems, also for the Manufacturing Hazards Council were confirmed as printed in the 1940 Year Book.

The Committee on Technical Committee Procedure reported consideration of requests for representation on the Electrical Committee received from the International Brotherhood of Electrical Workers, the Illuminating Engineering Society, the International Municipal Signal Association, and the Pacific Coast Electrical Association, also requests received for increased multiple representation of the National Electrical Contractors Association and the U. S. Conference of Mayors. It was reported that the Committee called a conference in July in coöperation with President Small at which all organizations now participating in the work of the Electrical Committee were invited to express their views on the committee organization. The opinions presented differed in detail, but there was general agreement to the effect that the voting membership of the committee should be limited to approximately its present size, if not decreased, in the interest of efficient operation.

On recommendation of the Committee on Technical Committee Procedure, it was accordingly voted that as a matter of policy the Electrical Committee should be limited to approximately its present size and that any further increase in multiple voting representation should be discouraged, but that this action was not intended to limit the number of individuals who may be brought into the work of the Electrical Committee in a capacity other than as voting representatives.

It was voted to invite the International Brotherhood of Electrical Workers to designate one voting representative to the Electrical Committee.

It was voted to invite the Illuminating Engineering Society to designate one voting representative to the Electrical Committee.

It was voted that the International Municipal Signal Association be accorded a limited membership on the Electrical Committee, affording repre-

sentation on article committees dealing with radio and signaling, and the privilege of the floor of the main committee meetings, but without vote in main meetings.

It was voted that no present increase be made in the voting delegation on the Electrical Committee of the U. S. Conference of Mayors and of the National Electrical Contractors Association, as this would be inconsistent with the policy outlined above.

It was voted that the representation of the American Institute of Architects on the Electrical Committee be terminated, the A.I.A. having advised that they were agreeable to this action.

It was voted not to grant the request of the Pacific Coast Electrical Association for representation on the Electrical Committee on the ground that the manufacturers, utilities, dealers and electrical engineers in its membership have representation through other organizations now represented on the committee.

The Committee on Technical Committee Procedure also reported that further consideration was being given to the organization of the Electrical Committee with a view to possible submission of further recommendations at a subsequent meeting of the Board.

7. A proposal from the Electrical Committee for reciprocal contacts between it and the committee responsible for the Canadian Electrical Code was tabled pending clarification of the international situation.

8. A communication from the Subcommittee on Procedure, Electrical Committee, relative to the provision in the N.F.P.A. Regulations on Technical Committee Procedure that the President shall be an ex-officio member of all committees, and the possible effect of this provision on the voting procedure in the Electrical Committee was presented. The discussion indicated that the matter is not of immediate practical significance, since no N.F.P.A. president has actually participated in his ex-officio capacity, and further that as the provision in question appears in the Articles of Association the Board has no power to make any change. The communication was tabled.

9. President Small reported on current developments on the American Standards Association, and his retirement from the A.S.A. Board of Directors. It was voted to express to Mr. Small the Board's sincere appreciation of Mr. Small's conscientious service to the N.F.P.A. during the nine years of his membership on the A.S.A. Board of Directors.

10. The Advisory Committee was authorized to review from time to time the personnel and functions of the non-technical committees of the Association and to make recommendations thereon to the Board.

11. General Manager Bugbee, reporting for Board Member Wilds, indicated progress in the development of a research project on fire gases at the Massachusetts Institute of Technology, as referred to Mr. Wilds by the Board at its last meeting.

12. The committee appointments referred with power to the President and the Committee on Technical Committee Procedure, and printed in the 1940 Year Book were confirmed, also the following:

Air Conditioning.

L. L. Lewis, Air Conditioning and Refrigerating Manufacturers Association, replacing W. E. Zieber.

City Planning and Zoning.

Harold W. Baker, with Eastman Kodak Company, Member at Large.

Dust Explosion Hazards.

Heston S. Hirst, Associated Factory Mutual Fire Insurance Cos., replacing N. J. Thompson.

Ralph M. Ferry, American Society of Mechanical Engineers, replacing J. H. Morrow.

Electric Railway Car Houses and Cars.

R. B. Smyth, American Transit Association, replacing John Lindall.

Finishing Processes.

E. C. Barnes, National Electrical Manufacturers Association.

M. K. Rouse, Board of Fire Underwriters of the Pacific.

Flammable Liquids.

Heston S. Hirst, Associated Factory Mutual Fire Insurance Cos., replacing A. B. Guise.

Hydrants, Valves and Pipe Fittings.

A. M. Houser, Crane Company.

Museums, Art Objects and Historic Buildings.

H. C. Kendall, National Automatic Sprinkler Association.

Daniel Mapes, Compressed Gas Manufacturers Association.

Ovens and Furnaces.

N. J. Thompson, Associated Factory Mutual Fire Insurance Cos., and R. D. Van Nordstrand, National Electrical Manufacturers Association.

Special Extinguishing Systems.

R. E. Abbott, General Motors Corporation.

A. B. Guise, Associated Factory Mutual Fire Insurance Cos.

Donald Knapp, Board of Fire Underwriters of the Pacific.

E. J. Meyers, National Paint, Varnish & Lacquer Association.

P. J. Zerbe, Edison Electric Institute.

Spontaneous Heating and Ignition.

F. J. Sanborn, Association of Mutual Fire Insurance Engineers.

Storage of Combustible Fibres.

George D. Suter, Cotton Engineering and Inspection Service.

Out of the Blackout.

Compiled by John A. West, Jr.,
N.F.P.A. Staff.

I.

Since the fall of France and the inception of the Battle of Britain, the Fire Service — Britain's first line of Passive Defense — has been enormously active. This we know. But at the same time, the reports reaching us from embattled Europe have been vague and obscure. Vague in reporting the actual fire problems as seen by British firemen, and obscure in their measurement of the success of the British fire service in their struggle against war incendiarism.

Now at last, information relating to these things has reached us out of the blackout that is England, 1941. We believe that much of this information will be of interest to those who are interested in fire defense.

A Word About Fire Departments.

For a better understanding of present day British fire problems and the methods being used to deal with them, one must be acquainted to a certain extent with the peace-time set-up of the British fire brigade, with the changes that have occurred in this set-up as a result of war, and with the differences existing between a British brigade and an American department. For this purpose, we select the London Fire Brigade and compare it to the New York Fire Department.

Greater London is an area covering approximately 700 square miles, but the district over which the London County Council exercises jurisdiction covers only an area of 118 square miles. It is within this smaller area that reside more than 4,470,000 of London's total population of 8,200,000. The London Fire Brigade protects only the 118 square miles of land over which the London County Council had jurisdiction. Various "town" brigades are held responsible for the rest.

In peace time, the London Fire Brigade is housed in 59 land stations and three river stations. For administrative purposes, the brigade is composed of two divisions, the first of which includes that territory north of the Thames, the second of which includes that territory south of the river.

These divisions are further divided into three districts each, with a superintendent in charge of each district. In routine fire fighting operations, the districts are nearly independent of one another. Alarms within each of these districts are received at the nearest fire station and are transmitted to the district headquarters only. Fires requiring up to twelve pumps (equivalent to a

A glossary of British fire terms appears on page 327.

Acme.

A small jewelry store gets a taste of fire. Fireman on the extreme left smokes his pipe as he works. Poster attached to pilaster on right depicts "how to fight a fire in an air raid." Poster has been partially torn away.

three-alarm fire in large United States cities) are considered district calls. Should greater aid be needed, a brigade call is made to secure the help of other districts. A brigade call provides a minimum response of twenty pumps, or the equivalent of a five-alarm fire in a large United States city. District headquarters are in direct telephone contact with one another and with the central control room at the headquarters of the London Fire Brigade. Each district control station and the Brigade control room have on file the apparatus assignment cards for the entire County fire area. Local fire stations have assignment cards for their districts only.

The central headquarters of the London Fire Brigade was built in 1937 and comprises two buildings. Included within these buildings are administrative offices, quarters for the men on duty, residential flats for the officers, a training school, appliances and Brigade cars, workshops for maintenance of apparatus, a gymnasium, canteen and control room.

In peace time, the personnel of the London Fire Brigade numbers approximately 2750 men. Equipment includes nine turntable ladders, eight turntable ladder pumps, 19 motor escape vans, 70 motor pumps, 63 dual purpose appliances, three emergency tenders, 21 lorries and four fireboats, and 63 miles of hose. The alarm system comprises 1731 boxes.

The new headquarters of the London Fire Brigade on Albert Embankment. In the lower right, a "fire float" is moored at its pier.

The number of actual fires attended by the London Fire Brigade in 1939 was 6309. Deaths resulting from fires numbered 15. The property loss amounted to approximately $3,000,000.

In comparison, the City of New York is 318 square miles in area, with a population of 7,500,000, and is served entirely by one fire department. The New York Fire Department is housed in 284 stations and nine fireboat waterfront stations which protect the 578 miles of waterfront. The department is divided into 14 divisions, including one waterfront division, and each of the divisions is further subdivided into battalions, of which there are 48. The battalions are composed of from five to nine companies each.

From three to four deputy chiefs are assigned to each division and are responsible to the central department headquarters. In the Boroughs of Brooklyn and Queens, the deputies are responsible to four Deputy Chiefs in Charge, who in turn are responsible to fire department headquarters.

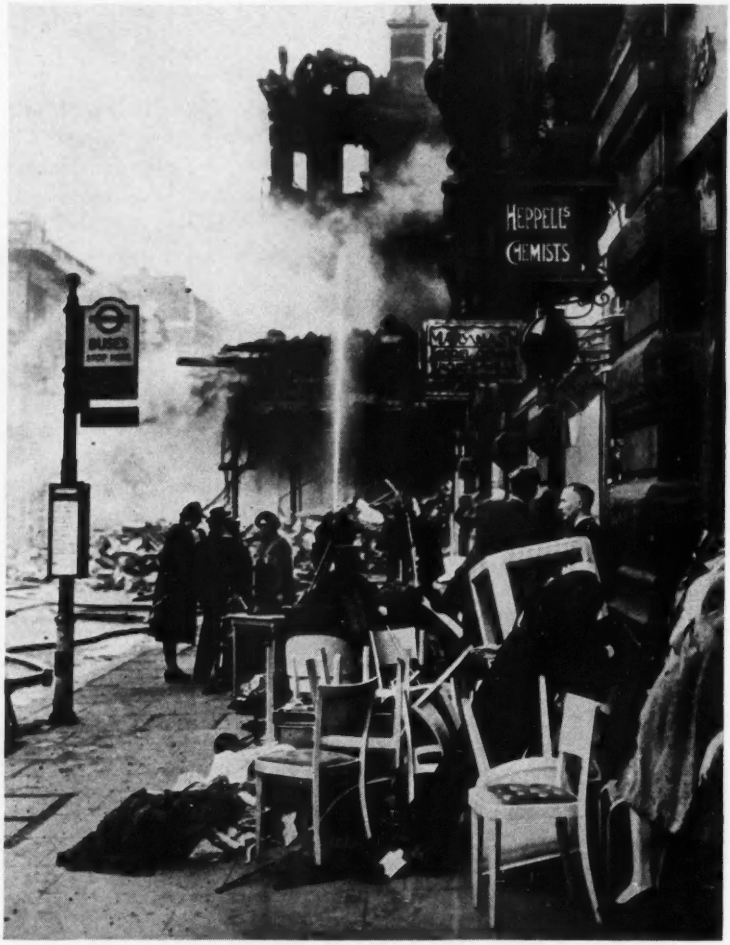
New York Fire Department bureaus, unlike the headquarters of the London Fire Brigade, are very much decentralized. That is, administrative headquarters, the several fire alarm central stations, maintenance workshops, training school and other branches of the department are not under one roof.

The personnel of the New York Fire Department numbers 10,390 men working on a three-platoon basis. Equipment includes 294 pumpers, 131 hose wagons, 169 hook and ladders, ten fireboats, eight water towers and approximately 200 miles of hose. Within New York City there are 10,300 alarm boxes which transmit their calls to three central alarm stations; one covering the boroughs of Manhattan and the Bronx, one for Richmond, and one for the boroughs of Brooklyn and Queens. A definite plan is continually in operation for mutual assistance among these areas. All fire alarms as received are announced on the municipal radio, and second alarm calls are sent to all central stations. Provision is made for shifting companies to other boroughs as needed to cover vacated stations.

The number of actual alarms attended in 1939 was 32,454. The number of lives lost as a result of fires was 71. Property damage during the year amounted to approximately $8,600,000.

Brigade Reorganization for Defense.

There are several reasons why the New York Fire Department is organized on a larger scale than the London Fire Brigade in peace time. Obviously, the New York department is responsible for the protection of a larger area and a greater number of lives. The City of New York, unlike London, is considerably broken up by waterways which hamper the transportation of fire apparatus from one part of the city to another, although use is made of the various bridges. It would also seem that the English are more "fire conscious" than Americans and consequently have fewer fires.



Acme.

No buses today. Firemen battle to stop the spread of fire in Piccadilly Circus where incendiary bombs have struck many familiar landmarks. Chairs and manikins have been salvaged from the shop on the right.

War has already brought about many changes in the organization of the British fire service, and particularly, of the London Fire Brigade.

First, it has been found necessary to organize a centralized control more nearly the same as the peace-time control in this country. In London, all alarms are now relayed to the central headquarters of the London Fire Brigade, where the location of every fire is shown on a large map. The superintendents

A "dual purpose appliance." This truck is a combination "escape" van and pump. The escape is a 50-foot ladder; the pump has a capacity of 700-900 gallons per minute. This truck also carries a "first aid" water tank and 600 feet of 2¾-inch unlined linen hose.

of the two major divisions of the Brigade are on duty at this headquarters station from which apparatus is directed about the city as needed to supplement local response.

Naturally, there are disadvantages to a centralized control of this nature, the main one being that enemy raiders are continually attempting to destroy the central control unit. This is true in London.

> "We went up [to the roof of Fire Brigade Headquarters in London] to look around. There were a number of German planes in the air and you could hear them more clearly than in the street....Two or three...droned across to us. The searchlights tried to find them. Mr. Blackstone [a British Fire Officer] said, 'They keep trying to hit us here.' "*

To offset this danger to such a vital center of London's defense activities, that center must be made impregnable to enemy bombs. This appears to have been done in London.

> "It [the control room of the London Fire Brigade] was a very deep cellar. I don't think any kind of bomb could have got to it...."*

In addition, all fire brigades of Greater London are now operating in close conjunction with the London Fire Brigade so that the fire service of Greater London more nearly resembles one unit than ever before. Fire brigades from other urban centers are also free to call other units of the fire service for aid.

**Report on England* by Ralph Ingersoll, Simon & Schuster, New York, November, 1940.

Acme.

Neither trucks nor trailer pumps could traverse this débris littered street and get near the seat of the fire. This is one of the gravest problems encountered in fighting war incendiarism.

Units from East Anglia, for example, are known to have fought fires in London on numerous occasions recently.

Thus, the British fire service has undergone extensive reorganization for the purpose of permitting mutual assistance among brigades. When there is a return to peace, it is doubted that the British fire service will revert to its independent district organization.

Personnel and Apparatus.

The increased number of fires from war incendiarism has necessitated a tremendous increase in the size of English fire brigades.

The London Fire Brigade, for example, has been increased from its peacetime level of approximately 2750 men, to 25,000 men and several thousands are being trained constantly to take the place of casualties. Thus far, it is estimated that nearly 3000 London firemen have been killed or otherwise incapacitated in the line of duty.

Fire brigades in England are being swelled from three sources. (1) Ex-firemen who have enrolled as reservists and who rejoin the brigade or who

make themselves available for emergency duty. (2) Auxiliary firemen, including men trained to particular duties, or in the case of London, as actual fire fighters. (3) Other persons with specialized training but not with the full training of firemen.

The reorganization of the British fire brigades has also called for additional apparatus and many new types of apparatus to deal with incendiary devices and the many new fire problems.

Most publicized of the numerous types of equipment being used currently in England is the trailer pump. This publicity has suggested to some that these pumps might serve a useful purpose in the United States.

Trailer pumps serve two purposes in England: (1) direct attacks on fires and (2) water relaying. Not generally known in the United States, however, is the fact that trailer pumps have always been standard pieces of equipment in the British fire service. The reason for the widespread use of trailer pumps abroad lies in the fact that the typical English automobile engine is relatively low-powered as compared with the typical American automobile engine. European engines have been geared to low power purposely in view of the high cost of petrol. Such low power makes such engines incapable of serving the dual purpose of pumper as well as driving mechanism.

The disadvantages of trailer pumps are many. They are incapable of carrying any large amount of hose. Space limitations also prevent the carrying of numerous small tools, ladders, poles, extinguishers and other devices which the American fireman depends upon in fighting fires to a considerable extent. Trailer pumps are also more difficult to maneuver in débris-littered streets than a self-propelled vehicle. They are too heavy, especially those units which have a capacity of at least 500 gallons per minute at 120 pounds pressure, to be handled by man power alone.

Conversely, trailer pumps have advantages. A trailer pumper is less expensive than a truck plus a pump. The advantages of two-piece operation of a fire company may be gained, if upon arrival at the fire, the trailer remains at the source of water and the truck continues to the fire, laying hose as it goes. Lastly, trailer pumps require a minimum of space in a fire station.

In the "blitz" on London of December 29 last, many water mains were either fractured or destroyed and it was necessary to relay water from London Bridge through delivery hose into the heart of the city. Trailer pumpers performed their work well. During the night, 750 pumps were in operation in London.

Trailer pump units being used currently in England vary considerably in their capacities and pressures. Capacities range from 120 to 700 gallons per minute; pressures from 80 to 100 pounds. Such pumps in addition to being mounted as trailer units have also been mounted in small boats to augment the regular river fire floats. These small boats have proved invaluable in fight-

British Combine.

Numerous devices for combating and extinguishing incendiary bombs have been invented and approved by the authorities. Two are shown here. On the left, steel claws grip the bomb to carry it away where it can burn without harm. The device on the right serves the same purpose.

ing pier and wharf fires which have occurred in the dockland area of London. In the United States, however, pumps are not recognized as suitable for supplying fire streams unless they can deliver at least 500 gallons per minute at 120 pounds pressure.

The British have also found the "turntable" ladder to be of great help to them, and auxiliaries are now being trained in the operation of these heavy appliances. In some brigades, this training started only after it was found that the auxiliaries were unable to operate such ladders when their regular operators were killed or wounded in the line of action by enemy raiders. The equipment could not be used until replacements arrived.

The London Fire Brigade drills in peace time. When the new brigade headquarters were built in 1937, a large drill yard and a nine-story drill tower were provided. Here, water is being supplied to a canvas dam by the pump on the left. The pump on the right then relays the water to the seat of the fire.

The list of devices for the extinguishment and handling of incendiary bombs is long indeed. New devices of this type are continuously appearing on the market.

Government Control of Fire Defense.

In Britain as in the United States, the various units of the fire service have always been supervised by the individual towns and cities in which the units are located. The national government has always regarded fire as a local problem calling for local supervision. The widespread use of fire as a weapon in the present war, however, has resulted in some changes in this policy.

Fire has now threatened Britain as a whole and has become a national problem. The Home Office has assumed some degrees of authority over fire fighting forces, but not with entirely favorable results. For naturally, the national government is inexperienced in the matter of fire service technique and in the matter of fire brigade administration. Specifically, some of the numerous objections to Home Office supervision of the fire service have been as follows, according to reports.

First, it was the Home Office that selected and placed fire-watchers, but in so doing, felt it necessary to place them on large premises only. Smaller buildings were disregarded. Naturally, large buildings of iron and concrete construction are capable of withstanding the shock of explosion and flames and heat more thoroughly than the small, antiquated buildings which have suffered the greatest damage in the "blitz."

Second: The national government has suggested that the Home Guard take among its duties the fighting of war incendiarism. This has stirred resentment among the officers and men of the fire service, who feel that the fire

British Combine.

Boys at the Moulcombe, Brighton, Schools in England are taught how to deal with incendiary bombs by members of the Brighton Fire Brigade. The boy directing the spray lies flat to protect himself against burning bits of flying magnesium. A stirrup pump supplying water is operated by a second boy 30 feet away.

problem is one in which men with specialized training are more valuable than large numbers without adequate training. It is felt among the men of the fire service that the Home Guard is a military unit and not one qualified to augment fire fighting forces.

Third: The Home Office has also interfered with the fire service by approving a "test" incendiary bomb which the fire service recognizes as nothing more than a flare. The fire service approves another "test" bomb. Incidents of this type seem petty, of course, but create friction which is not healthful and which cannot be tolerated if victory is going to be an ultimate achievement.

Fourth: The fire service expects the national government to feed and generally care for fire fighters on duty outside of their own areas. For naturally, in "blitzed" towns, there is a scarcity of food, and gas, electricity and water services are usually interrupted. The national government, on the other hand, believes it is the problem of the "blitzed" town to feed reinforcements. Suggestions have been made that mobile canteens be equipped and used to serve "blitzed" areas and particularly, the reinforcing fire fighters in such areas.

Fifth: There is growing discontent over the fact that fire brigades are not always under the command of qualified officers of the fire service.

Sprinkler Protection Against War Incendiarism.

In times of war, protection against fire differs little in actual theory from normal peace-time fire protection. Measures for protection, and fire protection devices and appliances which have proved their worth in peace-time use will, generally speaking, serve well in combating war incendiarism.

Sprinkler protection, for example, has already proved its worth against the incendiary bomb and against the fires resulting from both explosive and incendiary bombs.

The incendiary bomb is incapable of completely destroying either a sprinkler system or its water supply. After a bomb has penetrated the roof and the ceiling below the roof, little momentum remains for it to do further damage. And, of course, the typical incendiary bomb does not explode.

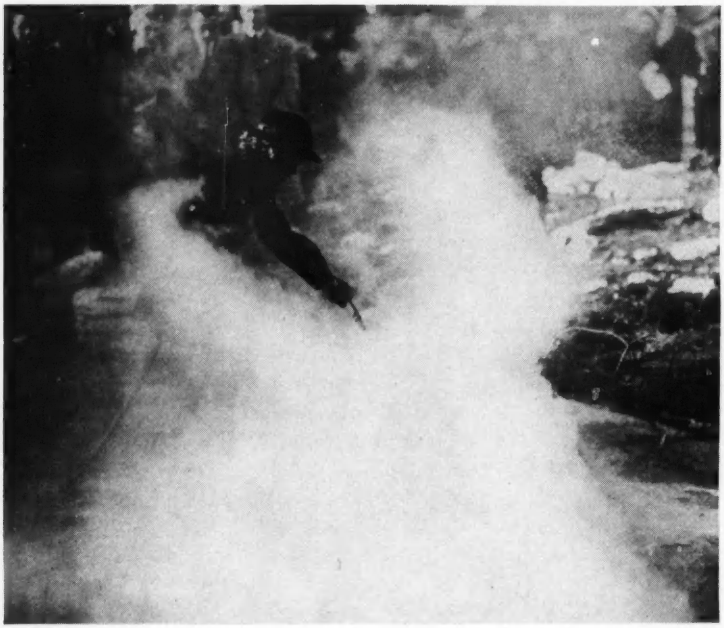
Upon impact, the thermite within the bomb reacts and its shell of magnesium is set ablaze. The type of water distribution produced by a sprinkler head is suitable for combating the incendiary bomb, and for all practical purposes the spread of fire to any surrounding material may be said to be similar to a peace-time accidental fire. The water from sprinklers will probably not extinguish the bomb, but will keep the surroundings cool and hold the fire in check. Several actual cases substantiate this theory.

In one instance, an incendiary bomb crashed through the roof of a factory and ignited celluloid goods on the floor below. A large open rack holding cardboard cartons which was suspended just below the roof was also ignited. Five sprinkler heads operated and left only the smouldering cardboard cartons to be dealt with when the fire brigade arrived.

In still another case, an incendiary bomb penetrated a slate roof and lath and plaster ceiling and dropped on the floor of a cloakroom below. One sprinkler head was sufficient to hold this bomb in check.

And again, a factory was hit by three incendiary bombs simultaneously. One of the bombs penetrated the roof of the boiler house, and dropped upon the top of one of the boilers, where it was extinguished with sand. Another of the bombs penetrated a storeroom and ignited some stored materials. Two sprinkler heads operated and held this blaze in check until plant engineers arrived. The third bomb penetrated a section of the plant in which woodworking operations were carried on, and set fire to highly combustible materials. This fire was also held in check by sprinklers until the arrival of the fire brigade.

In one case, the entire top floor of a sprinklered plant was destroyed. Here, however, it was found that the sprinklers were not to blame for the failure, but that the water supply was entirely inadequate. What had originally been a reliable and adequate water supply had been rendered ineffective by structural alterations. These alterations included increasing the height of sprinklers on the top floor without similarly increasing the water pressure.



British Combine.

A nine-year-old girl demonstrates how to extinguish an incendiary bomb with a spray nozzle.

The Explosive Bomb.

Naturally, a sprinkler system cannot withstand the shock of an explosion which cannot be withstood by the building in which the system is installed. Generally, however, a sprinkler system can withstand a shock that the building can withstand. Thus, if a building is partially destroyed by an explosive bomb, the sprinkler system in that section of the building can be expected to be destroyed also.

It is at once seen, however, that even though the sprinkler system is unharmed, there is still a possibility that the system's water supply can be entirely destroyed. It is therefore important that sprinkler systems installed for protection against war incendiarism be provided with secondary water supplies.

In one case, for example, explosive bombs fell simultaneously on a storage shed and a near-by office building. Each building was protected by automatic sprinklers, and portions of each of the systems were destroyed by the shock of the explosion. Nevertheless, other portions of the systems remained unharmed. Had a fire occurred on either of the premises, the sprinkler

systems would have been entirely inadequate. It was discovered that the water mains supplying them had been destroyed just before the buildings were hit. And neither system was provided with a secondary supply.

There are numerous cases on record which offer substantial proof of sprinkler systems standing up well under the tests of explosive bombing.

In one instance, for example, an explosive bomb caused considerable damage to a large store. A number of sprinkler heads were damaged by the explosion and considerable piping was fractured or destroyed. For the most part, however, the entire system, including the pressure tank in the basement, was unharmed. Had a fire resulted from the bombing, it would probably have been extinguished or held in check.

Another case reports that sticks of high explosive bombs were dropped extremely near a building and that more than 200 windows in the building were shattered. The sprinkler equipment was not affected.

In still another case, explosive bombs found their marks on buildings to the front and rear of a hall protected by outside open sprinklers. Pipes which fed the open heads were pierced in many places by flying splinters from the explosion. But the system would have operated entirely satisfactorily had fire threatened the hall.

II.

Part II of *Out of the Blackout* is an account by a Professional Fire Officer of his own personal experiences during one entire night of "blitz." This is a digest of the original account which first appeared in FIRE, the Official Publication of the British Fire Service.

Shortly after 5 P.M. our lookouts reported five large fires in the east about 12 miles distant. I went to an observation post and there, in the clear, bright atmosphere of that late afternoon, could see tongues of flame leaping skyward accompanied by enormous clouds of dense smoke. The spectacle was an unforgettable one, even for a fire engineer.

A regional mobilization order required that we dispatch our fireboat and six land pumps to the scene immediately. This was no sooner done when a hurried call was received for professional fire officers. Since my sector was not being affected by the raid in progress and since my officers and men were thoroughly capable of defending the sector should it become involved, I decided to volunteer for duty.

To accompany me on my mission, I took an A. F. S. section officer for my deputy, and for my messenger, a young regular fireman. At first, I was reluctant to take the regular driver of my staff car, a woman volunteer, but she expressed such keen disappointment that I finally consented to include her in the party. Later, I was glad that I had done so. She did splendid work in transmitting messages under fire; nothing daunted her.

In British terminology, this truck is a "pump." Its equipment consists of a 720-gallon pump and 120 horse power motor, 800 feet of hose, 40-foot extension ladder, and breathing apparatus. The pump shown also carries six men.

It was nearing dusk when we left our headquarters station in the L District of the London Fire Region and proceeded rapidly and with the aid of the glare from the fires to the Thames Embankment. Five more miles to go, and the heated air from the fire ground was already pouring into the car!

At the fire control center of the county borough in which were the fires, I met two other professional fire officers and together we reported to the officer in charge. He informed us that we were to meet the principal fire officer of the borough at a certain place, the name of which was familiar to each of us. Even in peace time, we knew it was a danger zone.

"Duck!" We were leaving for our posts when someone yelled the warning. An ominous rushing sound followed a lightning-like crack and everyone threw themselves flat upon the ground. I delayed a moment. Too late!

The Trip to the Fire Area.

I was down in a half crouching position when the bomb crashed on the other side of a near-by block of buildings. The glass scattering in all directions, the fall of brickwork, the breaking of wood, the terrific crack of the bomb, the trembling of the air and the sudden displacement of air stunned and dazed me. Now I knew how terrifying was the shock a high explosive aerial projectile could produce. For a few minutes while we attempted to recover, to think normally, none of us spoke a word. Thankful that we were safe, we entered the car and began our journey again.

As we drove along, we found that the road surfaces in many places had been replaced by deep craters or huge mounds of concrete and rubble thrown up by bomb explosions. In some parts, the roads had completely disappeared and it had been necessary to construct rough tracks before fire apparatus could proceed to the points at which it was needed. This upheaval of road surfaces necessitated numerous detours for our party. Whichever way we turned we

could see anti-aircraft shells bursting in the sky, and the beams from hundreds of searchlights. So strong was the reflection from the flames issuing from buildings still distant from us, that the powerful beams from the projectors of the searchlight battalions were, at times, totally eclipsed by it. Buildings riven by high-explosives stood silhouetted in the glare.

Beneath our feet lay street car rails distorted in all manner of grotesque shapes. Trolley bus standards bowed towards where the centre of the road had been, and, in places, the wires lay across the track. In others, the wires still in position were festooned with blankets and wearing apparel blown upon them by the blast of high-explosive bombs. All around were damaged shops and dwelling houses. Reflection of the flames on the panes of glass that remained in window frames presented an almost awe-inspiring spectacle, and an illusion of a myriad of small fires. I had seen air-raid damage in my own sector. But nothing on a scale approaching this!

When we reached a viaduct giving direct access to the quarter where our services were needed, army sentries under orders forbade us to cross. "Unexploded bomb," said one of them, indicating the center of the bridge. A detour meant four more miles for us, but we had no choice in the matter.

We had gone no more than 400 yards when we were told to turn back, that the roadway ahead had completely disappeared, and we were told of another alternate route. This alternate route took us down several streets absolutely devoid of human life. Doorways and window frames of buildings that remained gaped at us. There was no sound except the cannonade of anti-aircraft artillery and bursting enemy projectiles. Later, I learned that u-x-b's were so thick in this area that every inhabitant had been evacuated, every policeman and warden withdrawn.

Our new route led us nowhere. Exasperated, I ordered my driver to turn about and return to the viaduct. There we were blandly told by an Army sergeant that we had two chances if we insisted upon crossing. "You either go up or down if those bombs explode," he explained. "And if you go down, you'll die in the pond." The "pond" meant London River.

Fighting Fire Under Fire.

We managed to cross the bridge successfully and about three-quarters of a mile beyond, we found the borough fire chief standing a few yards from a crater in the centre of which was a u-x-b. At the moment, I thought he might have chosen some safer rendezvous, for our benefit if not for his own. I was soon to learn that there were so many d-a bombs in the vicinity that it was beyond human ingenuity to find a really safe spot.

What surprised me, and those with me, was his wonderful sang-froid. As a junior officer, I had known him to possess the courage of his own convictions, and I had always respected him for that. Yet, on meeting him in this bomb-

British Combine.

Members of the London Fire Brigade train at brigade headquarters. The men shown here are being trained in rescue work and the use of breathing apparatus for passing through dense smoke.

torn waste, ringed by numerous fires of the first magnitude, I expected to find him, to say the least, a little disturbed in thought and action. Not at all. There he stood, firm as a rock. In himself, he was a source of inspiration and encouragement to our party.

On my reporting to him, he said: "Thanks for coming. I want you to take charge of that fire immediately in front of us, a tar distillery. It's probably beyond all hope, but, I feel you can prevent the fire from spreading to that warehouse and that granary. You will find pumps and crews on the ground and if you want water, you can get it from the Thames 1¼ miles back, by relaying. Now good luck to you."

The warehouse and the granary appeared to be well alight, while, at the back of us, as the D.R.F.O. was speaking, was an enormous timber yard alight from one end to the other, and, behind it, two warehouses blazing furiously.

There were still more fires, but what immediately concerned me was the task which had been allotted to me. I felt I certainly needed all the good luck which he had wished should come my way. I had seen big fires before, such as four large factories going simultaneously, but on such occasions there had been two or three chief-officers coöperating with the local fire chief and no fractured water mains.

I was the only professional fire officer on the scene, but far from despondent, I began a swift tour of my part of the fire-ground. Stopping here and there I made rough plans of buildings involved, marked the sites of known delayed-action bombs, water supplies, and so forth. It has to be remembered that I was operating in an area to which I was a complete stranger.

Behind some warehouses, I discovered an oil depot in which were thousands of tons of oil in 40-gallon drums. Adjoining were a number of oil reservoirs each about one-fourth of the size of an average gasholder. Between the blazing buildings and what had been the road were four sets of railway lines on which were standing between 25 to 30 oil tankers. To move them farther from the burning buildings was impossible; a bomb had distorted the tracks and the tankers had to continue as a serious fire hazard.

The best site for a command post, or field h-q., had been marred by a bomb which might explode at any moment during the next four days, so I had to move my command-post about 20 yards farther down the railway track. This site, on the southwestern side of the fire, afforded a good view of all operations from the road side of the building and of many of the operations on the southern side. I had two fences cut down and the timbers placed across the rails, ready for the trailer pumps I had ordered up. When these arrived they were taken over the timbers to a water supply I had found, a small stream, about two feet in depth which kept them going for the next six hours.

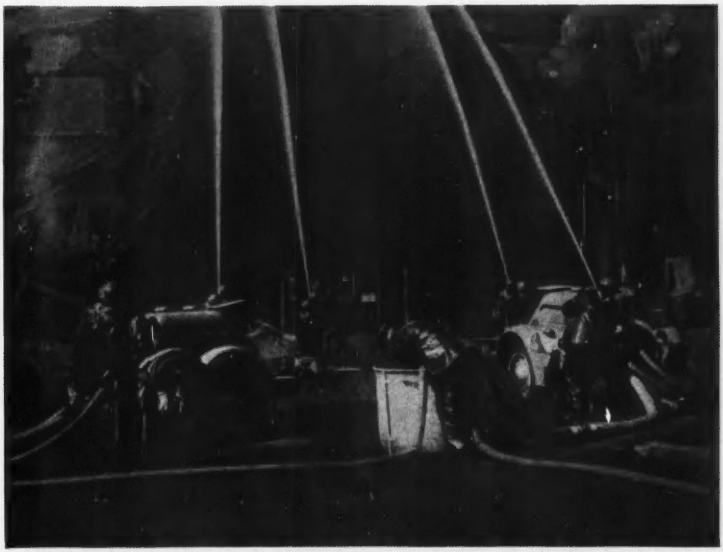
All this time, the enemy had not ceased his efforts to destroy every person and building within range. There was a regular procession of German aircraft overhead, regulated with the precision of a railway time-table in normal times. Every 10 minutes or thereabouts, another wave of raiders arrived, and with them came sticks of bombs.

The Problems of Petrol, Heat, and Food.

With all available pumps at work on good targets, I sent my deputy to a sub-station, about half a mile away, with a request for ten more pumps. The demand was supplied and, to my joy, I found the first pump to arrive was in charge of a section-officer of my town's A. F. S.

Conversant with his capabilities, I placed him in charge of the southern side of the building, with information gleaned from the rough maps I had made, as where best to put his pumps and to direct his jets. A little later, when I visited him, I found he had 15 pumps working merrily and five streams covering the whole of his side of the structure.

An all-steel "turntable" ladder. This truck is similar to the American aerial ladder and has been found to be very valuable in fighting blitz fires. A permanent nozzle at the top of the ladder permits water to be directed down into the seat of the fire.

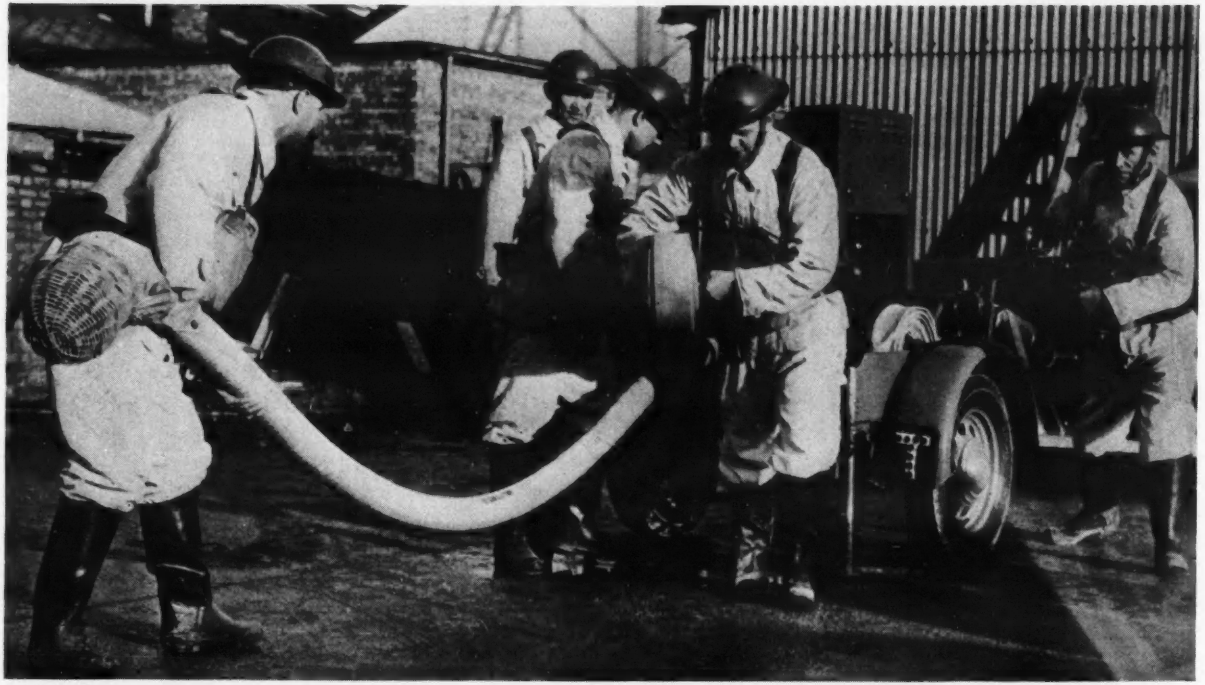


Two trailer pumps supply four streams to combat a Boche fire. These pumps deliver 500 gallons per minute at 100 lbs. pressure. They are known to have served continuously for three days.

At this juncture, I availed myself of the services of a regular fireman of the county borough's brigade, and placed him in charge of operations on the other side of the building. He distinguished himself by the manner in which he strategically placed the men and pumps under his command.

Meanwhile, my deputy at the command-post was receiving more pumps and crews, about a dozen or more. These were put to work, in series, to relay water to where it was most needed on the actual fire-ground. It was now 1 o'clock Sunday morning. Everything seemed to be going well, and, so far as I could see, my own immediate situation was developing favorably. I thereon decided to visit the crews at work. It was well that I did. Petrol supplies were running low — so low that one pump had been compelled to cease action altogether. The need was soon met by the arrival of supply for 50 pumps.

The branchmen were taking a considerable amount of heat punishment. The fire was so intense that radiated heat seemed to pierce the eyeballs. Covered in sweat, grime, and in some instances coagulated blood from lacerations of the head and face, the men were absolutely gasping for a drink. The only means to quench that torturing thirst was water from the Thames. Yet, never did I hear a murmur of reproach or complaint. The only mention made of the subject was a quiet observation from their officer that the men had been at work for nearly five hours and that he was wondering if it would be possible for them to have refreshment.



British Combine.

Somewhere in England, Air Raid Precaution workers in asbestos suits protect a factory. The basket on the end of the suction prevents foreign material from getting into the pump. Fireman fourth from the left is laying hose from spool. In England, most hose has been of the unlined linen type.

Returning to the command-post, I sent a dispatch rider to fire brigade headquarters to ask for the much-needed drink. Officers and men from my own town had each an iron-ration, but experience has taught me the energizing value of a cup of hot liquid, coffee, tea, or soup where a hard-toiling fireman is concerned. This experience had been gained at large fires in peace time; but officers and men that night and morning were facing, and accepting, conditions one hundred times worse than those at any peace-time blaze.

The dispatch rider returned with a message that all service mains had been broken, or fractured, and that there was neither heat nor water available at the station. However, a mobile-canteen could be expected to make its appearance shortly.

I now became aware that my tongue seemed like an enlarged rasp, that my throat was comparable to the surface of sandpaper. The salivary glands refused to act on a morsel of chocolate.

It was then that my driver recalled that she had an orange in the car. It was divided among the four of us, and, as I made the most of my portion of the fruit, my mind flashed back to the New Testament story of the feeding of the five thousand with five small loaves and two fishes. Especially, as the portion, small as it was, proved most satisfying.

At 2:30 our grip on the fire was strengthening materially. The Boche was still active, and keeping well to time schedule. His "sticks," however, were not so frequent in our immediate vicinity as they had been during the previous evening and night. All the same, he gave us a few occasionally. They had, however, no effect whatever where retardation of our work was concerned.

Tongues of Fire.

A short distance from our "ground" a good deal of property was well alight. This led me to requisition water-units to relay from the Thames to a point from which the water could be taken to my own fires and to those of my neighbors. The only water-unit available was dispatched to me and no time was lost in relaying water to the common "dump."

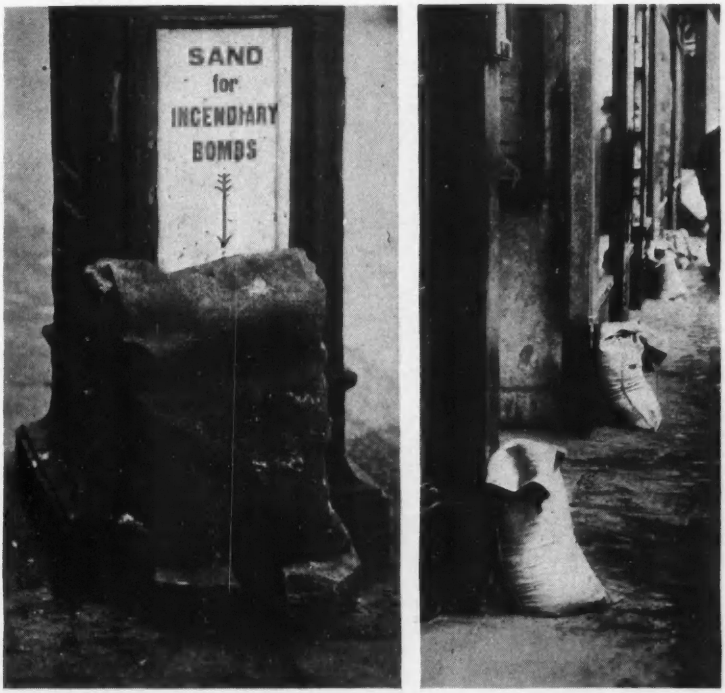
During the major part of the night before, I had been engaged in my own town in dealing with outbreaks, which had been followed during daylight hours by three more fires, all of which I had attended. I was now beginning to feel tired.

The last fragment of lassitude, however, vanished when pieces of granite and rubble fell around us like grapeshot. A d-a bomb had burst, and had bespattered all around with débris.

With the water-unit at work, I returned to the command-post to detect the odor of volatilizing petrol. A two-gallon tin had been punctured by a missile and was leaking badly. This made me concerned for the safety of my petrol "dump," which, if ignited, would practically ring about 20 pumps and

British Combine.

Fire walls prevented the spread of fire from the gutted building on the right to the building occupied by Fox Photos on the left. Peace-time fire protection methods have been found to be good methods in combating war incendiarism.



British Combine.

Bags of sand have been placed at numerous points throughout London to aid in combating the incendiary bomb. The bag at the left has been placed on bricks to keep the sand dry. Moisture tends to accelerate the burning of the bombs. Bags of sand in the picture to the right are partially protected against rain by roof eaves above.

their crews with flames. The hazard was immediately removed by the petrol being issued to all pumps still in action, and the empty cans placed where they were least likely to do damage.

Three of my pumps had definitely broken down and it was impossible to obtain the service of any of the mobile workshops, for which there was a considerable demand. And what a vast advantage would a turntable-ladder have proved. It would have materially shortened the struggle. The best we could do to get downward streams into the heart of the fire was to get branches working from the roof of a near-by warehouse, which had escaped ignition.

Reports from various parts of the fire-ground were that all was proceeding well, and according to plan. More water-units were arriving at the command-post, and, generally speaking, there was little to worry about, except, of course, the sticks of bombs from the Boche overhead.

Fire.

The latest in British fire equipment. A lorry capable of carrying ten men and 1000 feet of hose, combined with an "escape" and trailer pump. The trailer pump can be attached to, or detached from the lorry without removing the "escape."

Suddenly, the cherry-hue of the flames became lighter as though the roof was about to collapse, or a wall to go. The progression toward white-glare proceeded alarmingly and I at once knew that something unusual was happening, especially when tongues of fire began to leap hundreds of feet into the air.

Hose Line Bomb.

I was leaving the command-post to make personal inspection when the officer in charge of the south side of the building ran in, almost breathless, to report that some of the pumps were picking up oil and passing it to the flames!

Hurrying to the water stream, I found that its level had fallen considerably and that, on the surface, there was a two to three-inch layer of oil! A fireman now arrived to tell me that the oil effluent was due to a bomb having wrecked an oil tank just previously. This meant an end to this source of supply.

Fortunately, other water-units were available, and, also, the bomb, in wrecking the tank, had failed to start another fire.

Orders to shut down pumps were given. The flames from the building, still towering to an enormous height, were accompanied by dense black clouds, which at an altitude of 80 to 100 feet burst with a noise equaling that of the enemy bombs.

In less than 10 minutes, the pumps were at work again. Before this, however, a member of the town's established fire brigade had displayed commendable initiative by putting some pumps to draft water lying in bomb craters.

It was now our task to regain lost ground and to continue to prevent the fire spreading to the oil depot. Serious as the situation might be we were still sufficiently British to enjoy a quiet laugh at our own expense.

Water was passing from the water-units to the pumps when I noticed a burst in one of the lines of hose. I turned to tell a man to get a hose bandage, when I saw everyone around me taking cover. I followed suit.

We waited for the explosion. Seconds fled. An auxiliary near me exclaimed, "I wish the ruddy thing would drop." I asked him to what he was referring, and he replied by asking me if I could not hear the whistle of a falling bomb.

Glossary.

British fire terms are used throughout this article in many instances. Undoubtedly, many of the readers of the QUARTERLY are acquainted with these terms. For those who are not, however, this glossary is being printed. It is not intended to be a complete list of all British fire terms, but rather it is intended to cover some of the most interesting and important.

British Fire Term	Corresponding American Equivalent
Appliance	Piece of motor apparatus
Basement spray	Distributor nozzle
Branch	Nozzle or playpipe
Branchman	Hoseman or pipeman
Breeching	Wye connection
Calls	Alarms
Brigade call	20 pumps, equivalent to fifth alarm response in large United States cities
District call	12 pumps, equivalent to third alarm response in large United States cities
Home call	4 pumps, equivalent to box alarm response in large United States cities
Dry riser	Fire department standpipe
Dual-purpose appliance	Quadruple combination pump, hose, ladder and booster truck
Emergency tenders	Rescue trucks
Escape line	Life line
Escape van	Combination hose and ladder truck carrying a 50 or 55-foot ladder
External drenchers	Outside sprinklers
Fire float	Fire boat
First aid apparatus	Booster tank and hose
First aid tubing	Booster hose
Jumping sheet	Life net
Lorry	Motor truck
Nozzle	Nozzle tip
Occurrence book	House journal
Preventers	Plaster hook or pike pole
Reviving apparatus	Inhalators
Series pumping	Relay pumping
Turntable ladders	Aerial ladders
Abbreviations.	
A.F.S.	Auxiliary Fire Service
D-a bomb	Delayed action bomb
D.R.F.O.	District Regional Fire Officer
P.F.O.	Professional Fire Officer
U-x-b	Unexploded bomb

International.

Fire rings London's St. Paul's Cathedral. This picture was taken following a night of "blitz."

The only sounds evident to me were those of the pumps at work and that of the escaping water from the hose. It was this latter noise which was causing all the alarm. Everyone now laughed at himself and plunged into the contest again.

The first fingers of dawn were now in the eastern sky. It seemed to me that I had been days on the job. The Boche appeared to have come to stay, too, because he let loose a stick of bombs just about this time and started fires 200 yards to the rear of my command-post.

Ringed by Fires.

At no time had the air been what one could truthfully describe as fresh. Instead, one inhaled an atmosphere charged with smoke, fumes, heat and dust at every breath. Now when these latest fires, to our rear, got going our eyes and lungs received heavy punishment. I saw strong, smoke-inured firemen coughing, retching and finally vomiting the meagre contents of their stomachs. Lack of steam, or spray, from branches, combined with aridity of mouth and throat, made attack by these highly concentrated, dry fumes on the human system comparatively easy.

We were now ringed by fires. In alternate tours of our own ground my deputy and I were able to withdraw a number of pumps, practically no longer needed, and to dispatch them, under a patrol officer, to the officer in charge of the fire at the rear of us.

At this juncture, officers and men working under my direction were cheered by the news that a mobile-canteen making for our parts had been sighted. Hopes ran high, and they were soon fulfilled by the arrival of the van with good tea and meat extract. Following an absence of about 30 minutes my deputy returned to the command-post, bringing with him a messenger carrying what he identified to me as a "mug of hot tea."

The exterior of the mug was plentifully adorned with tarry fingerprints and the contents were a turgid, cold liquid, surmounted by what appeared to the taste to be creosote. I drank the mixture, whatever its ingredients were, and enjoyed it.

The major fire on our "ground" was beginning to die down; the severely burned warehouses had been well flooded and no flames were coming from them; dense clouds of smoke were still rolling off the tar distillery.

Daylight proved a boon. We now could see where we were, so to speak, and what had been the result of our work. Visually, there was evidence that in a few more hours there should be nothing more to be done, except, perhaps, to damp down here and there. And especially, if the sudden surcease of Boche planes were to continue. With their disappearance, anti-aircraft gunfire had ceased, and, at 5:15 one could honestly feel that it was good to be alive. Then came the "All Clear."

Although many of the officers and men who had labored unceasingly in the face of great heat punishment and physical danger were due to be relieved, none asked to be withdrawn from the fight. Several were obviously suffering acutely from the effects of fumes. Tactfully, without hurting their feelings, I told them they were required to man a number of pumps that were to be made up and dispatched elsewhere. In this way, they passed to their well-earned spell of relief.

Truthfully, I cannot find words sufficient to express the sterling worth of the regulars and auxiliaries under my command at that great fire. I knew the reputation of the Fire Service for grit and resolution, but these officers and men did what many would have deemed to be the impossible.

A Word About Men.

I daresay that a similar claim can be made for other officers and men on that enormous fire-ground. Naturally, I could not be everywhere. All I can do is to speak of what occurred in my own vicinity.

When bombs crashed, the branchmen stuck grimly at their posts, never flinching, never "ducking" as we others "ducked." They stood like statues, bent on one thing only — and that was getting the utmost amount of value out of the branches under their control. The discipline was superb.

At one phase, a bomb dropped within a few feet of an officer and a crew at work from the roof of a warehouse. It failed to explode. The officer in notifying me of the fact, said he and his men were staying where they were, pending orders to the contrary from me!

This was the sort of discipline that pervaded the whole of these regulars and auxiliaries, every one of whom had probably never seen or heard of me before that Saturday night. Their commanding officer should be proud of them, as doubtless he was long before I had the honor of meeting them.

At 7 o'clock reliefs for those who had been working at the fire throughout the evening and the night began to arrive. But, in many instances, it was with difficulty that these hard-pressed blitz-fighters could be prevailed upon to knock off and take their well-earned spell of rest.

The fires were all under command, most of the buildings were full of steam, but these heroes wanted to remain until the final "bulls-eyes" had been doused. I was now notified that a principal officer was being sent to relieve me so that I might return to my duties in my own town "above bridge."

As my party was entering the staff car I took a final look around. During the night I had formed the impression that daybreak would reveal nothing but fire-swept débris of factories, warehouses and oil installations. *Actually, it disclosed that the damage by fire in my immediate vicinity was really small compared with the number of buildings that had been untouched by flame and heat.*

Chicago Fire Prevention Exhibit.

A Fire Prevention Exhibit held in Chicago February 1-15, stressing the importance of Fire Prevention in our National Defense Program, was a tremendous success, according to reports of the Chicago Fire Department and the Chicago Association of Commerce's Fire Prevention Committee, joint sponsors of the exhibit. A record crowd of more than 36,000 persons attended.

Civic, educational and industrial leaders participated in the opening of the exhibit, which included an address by Mayor Edward J. Kelly. Fire department equipment was placed on display and actual fire alarms were transmitted to visitors. Proper methods of turning in fire alarms were also explained.

Other exhibits included those of the Insurance Company of North America, the Illinois District Telegraph Company, the Fire Insurance Patrols, and the Western Actuarial Bureau. Two $200.00 art school scholarships were awarded winners in the Chicago school poster contest.

This successful exhibit in Chicago is an example of the fine Fire Prevention work that can be carried on throughout the year. That Fire Defense will play an important part in our program of National Defense is becoming increasingly evident.

Fire Record of Cities, 1940.

The following tabulation prepared by the N.F.P.A. Department of Fire Record gives 1940 fire record data for cities in the United States and Canada which have populations of over 25,000. Blanks in the tabulation indicate that the cities do not report these figures or have not responded to requests for their reports. The only city of more than 100,000 population for which 1940 fire loss figures could not be obtained was San Francisco, which has not reported its fire losses for many years.

The questionnaire sent to the various cities specifically asked that the city fire loss data reported include both insured and uninsured losses, and that both chimney and roof fires be included in the number of building fires. However, reports of the cities are not all compiled on a uniform basis. Differences in methods of determining or estimating fire losses, and in differentiating between alarms and building fires, should be considered in any use of these figures for comparison between cities.

In addition to the 1940 fire records of individual cities, this survey provides a good picture of the fire experience of the United States and Canadian cities as a group. Three hundred and ninety-six United States cities having over 25,000 population, according to the 1940 U. S. Census, reported a total fire loss for the year 1940 of $80,063,460, amounting to an average loss per person of $1.55 for the 51,434,676 inhabitants of this group of cities. Twenty-four Canadian cities reported a total loss of $5,753,874.

A total of 389 U. S. cities reported both loss data and the number of building fires. The average loss per building fire in these cities for the year 1940 was $384. The average loss per building fire for 23 Canadian cities reporting both losses and number of fires was $411. The total number of building fires reported by 390 U. S. cities was 207,192, an average of 4.01 per 1000 population. Twenty-three Canadian cities reported exactly 14,000 building fires.

1940 Fire Losses, Cities of 25,000 Population or Over.

City	1940 Population	Total Loss	No. Alarms	No. Bldg. Fires	Bldg. Fires per 1000 Population
Alabama					
Anniston	25,523	$31,281	349	300	12.0
Birmingham	267,583	335,976	3,146	1,242	4.6
Gadsden	36,975	38,656	444	211	5.7
Mobile	78,720	70,849	1,625	973	12.4
Montgomery	78,084	167,013	570	370	4.7
Tuscaloosa	27,493	23,216	293	164	6.1
Arizona					
Phoenix	65,414	79,889	556	253	3.9
Tucson	36,818	64,051	334	149	4.0

City	1940 Population	Total Loss	No. Alarms	No. Bldg. Fires	Bldg. Fires per 1000 Population
Arkansas					
Fort Smith	36,584	22,073	517	186	5.2
Little Rock	88,039	110,000	1,557	....	....
California					
Alameda	36,256	13,222	309	284	7.9
Alhambra	38,935	11,752	257	59	1.5
Bakersfield	29,252	90,887	376	89	3.0
Berkeley	85,547	63,543	803	363	4.2
Beverly Hills	26,823	27,570	195	75	2.8
Burbank	34,337	13,792	322	68	2.0
Fresno	60,685	181,694	336	154	2.5
Glendale	82,582	22,185b	651	453	3.0
Huntington Park	28,648	44,838	163	56	5.4
Inglewood	30,114	5,380	153	43	1.4
Long Beach	164,271	99,246	984	294	1.8
Los Angeles	1,504,277	1,500,000a	13,423	3,553	2.3
Oakland	302,163	298,154	2,966	1,140	3.8
Pasadena	81,864	33,445	477	161	1.9
Riverside	34,696	75,470	272	92	2.6
Sacramento	105,958	253,510	1,179	434	4.1
San Bernardino	43,646	37,774	466	120	2.7
San Diego	203,341	121,048	1,864	553	2.7
San Francisco	634,536	....	7,954	3,802	6.0
San Jose	68,457	57,384	573	258	3.8
Santa Ana	31,921	12,609	218	74	3.3
Santa Barbara	34,958	29,536	343	107	3.0
Santa Monica	53,500	56,921	348	126	2.4
South Gate	26,945	10,276	264	51	1.9
Stockton	54,714	98,336	796	589	10.7
Colorado					
Colorado Springs	36,789	23,052	297	159	4.3
Denver	322,412	202,925	2,405	1,181	3.6
Pueblo	52,162	40,155	653	318	6.1
Connecticut					
Bridgeport	147,121	149,230	1,050	421	2.9
Bristol	30,167	77,095	298	75	2.5
Greenwich	35,509	177,844	458	134	3.8
Hartford	166,267	168,063	1,343	623	3.7
Meriden	39,494	38,571	323	136	3.5
Middletown	26,495	12,813c	145	93	3.6
New Britain	68,685	208,336	645	167	2.4
New Haven	160,605	196,486	1,913	694	4.3
New London	30,456	29,660	453	176	5.8
Norwalk	39,849	16,777	552	186	4.6
Stamford	47,938	196,341	461	143	2.9

a. Estimated. b. June 1939-June 1940. c. First tax district only.

City	1940 Population	Total Loss	No. Alarms	No. Bldg. Fires	Bldg. Fires per 1000 Population
Connecticut (Cont'd)					
Torrington	26,988	67,083	232	139	5.1
Waterbury	99,314	169,378	1,264	380	3.8
West Hartford	33,776	63,283	352	102	3.0
Delaware					
Wilmington	111,432	169,569	780	419	3.7
District of Columbia					
Washington	663,091	708,775	6,792	2,214	3.3
Florida					
Jacksonville	173,065	151,758	2,164	1,518	8.7
Miami	172,172	167,729	2,757	445	2.6
Miami Beach	28,012	5,242	296	79	2.8
Orlando	36,736	36,334	486	111	3.0
Pensacola	37,449	....	....	....	....
St. Petersburg	60,812	37,910	197	164	2.7
Tampa	108,391	119,735	1,398	....	....
West Palm Beach	33,693	48,929	321	95	2.8
Georgia					
Atlanta	302,288	835,924	4,511	1,532	5.0
Augusta	65,919	....	....	....	....
Columbus	53,280	56,236	645	369	6.9
Macon	57,865	28,193	548	299	5.1
Rome	26,282	33,735	382	195	7.5
Savannah	95,996	92,731	1,119	512	5.3
Idaho					
Boise	26,130	13,871	280	129	4.9
Illinois					
Alton	31,255	115,375	336	135	4.3
Aurora	47,170	35,884	590	280	5.9
Belleville	28,405	32,935	318	91	3.2
Berwyn	48,451	18,195	189	82	1.7
Bloomington	32,868	33,874	417	210	6.3
Chicago	3,396,808	4,850,000	27,122	11,174	3.3
Cicero	64,712	49,605	359	214	3.3
Danville	36,919	52,727	548	212	5.7
Decatur	59,305	201,744	648	373	6.3
East St. Louis	75,609	126,158	1,079	449	5.9
Elgin	38,333	16,628	310	147	3.9
Evanston	65,389	710,575	600	291	4.5
Galesburg	28,876	22,211	314	....	....
Joliet	42,365	98,927	428	219	5.2
Maywood	26,648	19,106	184	139	5.3
Moline	34,608	35,656	392	66	1.9
Oak Park	66,015	24,427	487	243	3.7

City	1940 Population	Total Loss	No. Alarms	No. Bldg. Fires	Bldg. Fires per 1000 Population
Illinois (Cont'd)					
Peoria	105,087	294,782	1,193	466	4.4
Quincy	40,469	35,746	609	269	6.7
Rockford	84,637	104,548	1,056	754	8.9
Rock Island	42,775	84,565	448	420	9.8
Springfield	75,503	202,311	941	340	4.5
Waukegan	34,241	37,573	425	214	6.3
Indiana					
Anderson	41,572	28,918	718	345	8.2
East Chicago	54,637	40,193	541	85	1.5
Elkhart	33,434	19,992	427	231	7.0
Evansville	97,062	122,996	1,390	584	6.0
Fort Wayne	118,410	69,169	1,609	474	4.0
Gary	111,719	98,101	1,374	659	5.9
Hammond	70,184	40,890	718	290	4.1
Indianapolis	386,972	490,000	3,780	1,947	5.0
Kokomo	33,795	18,248	504	285	8.4
Lafayette	28,798	170,366	415	105	3.6
Marion	26,767	40,330	417	181	6.7
Michigan City	26,476	14,979	324	168	6.5
Mishawaka	28,298	22,096	288	186	6.6
Muncie	49,720	107,331	749	349	7.0
New Albany	25,414	21,052	366	236	9.4
Richmond	35,147	17,813	455	312	8.9
South Bend	101,268	218,681	1,401	727	7.2
Terre Haute	62,693	237,400	826	530	8.4
Iowa					
Burlington	25,832	64,883	529	277	10.6
Cedar Rapids	62,120	71,460	671	368	5.9
Clinton	26,270	18,490	353	257	9.9
Council Bluffs	41,439	62,309	464	279	6.8
Davenport	66,039	211,129	732	131	1.9
Des Moines	159,819	286,905	2,523	893	5.6
Dubuque	43,892	22,004	742	373	8.5
Mason City	27,080	45,451	282	136	5.0
Ottumwa	31,570	145,288	433	192	6.2
Sioux City	82,364	179,304	823	425	5.2
Waterloo	51,743	121,605	765	345	6.6
Kansas					
Hutchinson	30,013	60,940	408	160	5.3
Kansas City	121,458	502,479	1,795	711	5.9
Topeka	67,833	141,004	850	440	6.5
Wichita	114,966	198,239	1,416	353	3.1
Kentucky					
Ashland	29,537	21,686	311	159	5.5
Covington	62,018	17,857	650	621	10.0

City	1940 Population	Total Loss	No. Alarms	No. Bldg. Fires	Bldg. Fires per 1000 Population
Kentucky (Cont'd)					
Lexington	49,304	158,493	717	203	4.1
Louisville	319,077	412,080	3,411	1,209	3.7
Newport	30,631	73,662	260	167	5.4
Owensboro	30,245	174,280	510	334	11.1
Paducah	33,765	....	....	....	....
Louisiana					
Alexandria	27,066	17,977	303	112	4.1
Baton Rouge	34,719	67,366	315	255	7.3
Monroe	28,309	....	....	....	....
New Orleans	494,537	317,253	2,913	1,122	2.2
Shreveport	98,167	250,909	962	358	3.6
Maine					
Bangor	29,822	38,957	711	556	18.5
Lewiston	38,598	44,562	740	606	15.9
Portland	73,643	90,678	1,271	308	4.1
Maryland					
Baltimore	859,100	2,889,486	8,323	4,456	5.2
Cumberland	39,483	150,971	376	223	5.7
Hagerstown	32,491	....	....	....	....
Massachusetts					
Arlington	40,013	37,946	483	....	....
Belmont	26,867	33,275	402	122	4.5
Beverly	25,537	83,201	601	154	6.1
Boston	770,816	2,740,502d	10,803	3,840	5.0
Brockton	62,343	141,377	1,478	531	8.6
Brookline	49,786	83,163	683	425	8.5
Cambridge	110,879	230,857	1,768	1,394	12.7
Chelsea	41,259	183,736	504	199	4.8
Chicopee	41,664	74,863	586	177	4.2
Everett	46,784	95,071	808	142	3.0
Fall River	115,428	385,598	1,011	359	3.1
Fitchburg	41,824	166,839	600	291	6.9
Haverhill	46,752	220,761	1,039	355	7.5
Holyoke	53,750	67,331	746	398	7.4
Lawrence	84,323	164,557	964	244	2.9
Lowell	101,389	357,386	1,394	497	4.9
Lynn	98,123	282,441	1,841	503	5.1
Malden	58,010	138,303	804	238	4.1
Medford	63,083	90,037	877	217	3.4
Melrose	25,333	29,369	292	71	2.8
New Bedford	110,341	158,647	874	375	3.4
Newton	69,873	79,871	1,178	294	4.2
Pittsfield	49,684	204,585	510	207	4.1

d. Insurance loss only.

City	1940 Population	Total Loss	No. Alarms	No. Bldg. Fires	Bldg. Fires per 1000 Population
Massachusetts (Cont'd)					
Quincy	75,810	268,980	1,256	369	4.8
Revere	34,405	137,249	786	134	3.9
Salem	41,213	153,802	701	188	4.6
Somerville	102,177	302,322d	1,425	460	4.5
Springfield	149,554	343,416e	1,838	504	3.3
Taunton	37,395	34,283	689	605	16.3
Waltham	40,020	60,670	718	160	4.0
Watertown	35,427	41,509	419	29	0.8
Worcester	193,694	776,563	3,117	976	5.0
Michigan					
Ann Arbor	29,815	56,456	154	139	4.6
Battle Creek	43,453	40,660	271	169	3.9
Bay City	47,956	191,700	711	158	3.3
Dearborn	63,584	75,615	509	163	2.6
Detroit	1,623,452	2,442,630a	13,650	6,892	4.2
Flint	151,543	131,749	1,574	916	6.0
Grand Rapids	164,292	201,215	1,237	387	2.3
Hamtramck	49,839	117,752	504	334	6.7
Highland Park	50,810	60,114	483	223	4.3
Jackson	49,656	109,620	680	446	9.0
Kalamazoo	54,097	157,785	691	463	8.5
Lansing	78,753	54,304	956	231	2.9
Muskegon	47,697	134,301	458	201	4.2
Pontiac	66,626	75,251	523	357	5.3
Port Huron	32,759	71,090	451	256	7.8
Royal Oak	25,087	31,294	278	111	4.4
Saginaw	82,794	80,702	903	395	4.7
Wyandotte	30,618	14,923	234	114	3.7
Minnesota					
Duluth	101,065	226,024	1,108	688	6.8
Minneapolis	492,370	956,111	3,675	1,040	2.1
Rochester	26,312	14,000	316	121	4.6
St. Paul	287,736	575,352	2,746	995	3.5
Mississippi					
Jackson	62,107	79,260	719	296	4.8
Meridian	35,481	45,872	461	203	5.8
Missouri					
Joplin	37,144	23,940	946	249	6.7
Kansas City	399,178	835,804	5,542	2,377	5.9
St. Joseph	75,711	402,470	1,306	....	....
St. Louis	816,048	878,372h	7,802	3,670	2.0
Springfield	61,238	55,178	1,048	488	8.0
University City	33,023	15,300	461	258	7.8

a. Estimated. d. Insurance loss only. e. Incomplete. h. Jan. 1, 1940-June 30, 1940, inclusive.

City	1940 Population	Total Loss	No. Alarms	No. Bldg. Fires	Bldg. Fires per 1000 Population
Montana					
Butte	37,081	84,210	354	161	4.3
Great Falls	29,928	56,419	342	44	1.4
Nebraska					
Lincoln	81,984	68,765	882	343	4.2
Omaha	223,844	407,941	2,463	967	4.3
New Hampshire					
Concord	27,171	22,296	601	455	16.8
Manchester	77,685	124,822a	846	348	4.5
Nashua	32,927	150,380	563	362	10.9
New Jersey					
Atlantic City	64,094	51,286	621	329	5.1
Bayonne	79,198	50,367	738	403	5.1
Belleville	28,167	8,575	284	48	1.7
Bloomfield	41,623	15,778	355	111	2.6
Camden	117,536	330,169	1,174	386	3.3
Clifton	48,827	314,914	407	55	1.1
East Orange	68,945	47,132	444	175	2.5
Elizabeth	109,912	106,489	684	300	2.7
Garfield	28,044	34,175	62	39	1.4
Hackensack	26,279	36,083	290	89	3.4
Hoboken	50,115	109,540	371	157	3.1
Irvington	55,328	65,712	382	140	2.5
Jersey City	301,173	88,020	2,071	1,087	3.6
Kearny	39,467	219,929	257	95	2.4
Montclair	39,807	40,383	452	204	5.1
Newark	429,760	827,872	3,695	1,957	4.5
New Brunswick	33,180	19,546	359	126	3.8
Orange	35,717	40,782	247	74	2.0
Passaic	61,394	183,503	425	213	3.5
Paterson	139,656	327,604	1,015	459	3.3
Perth Amboy	41,242	....	....	....	....
Plainfield	37,469	69,685	466	155	4.2
Teaneck Twp.	25,275	14,430	508	95	3.8
Trenton	124,697	149,021	994	470	3.7
Union City	56,173	29,540	645	211	3.8
West New York	39,439	70,934	337	184	4.7
West Orange	25,662	35,970	248	55	2.2
New Mexico					
Albuquerque	35,449	21,776	288	141	4.0
New York					
Albany	130,577	510,435	1,683	827	6.3
Amsterdam	33,329	124,154	209	104	3.1
Auburn	35,753	27,023	276	111	3.1
Binghamton	78,309	107,794	581	259	3.3

a. Estimated.

City	1940 Population	Total Loss	No. Alarms	No. Bldg. Fires	Bldg. Fires per 1000 Population
New York (Cont'd)					
Buffalo	575,901	1,651,473	3,246	1,282	2.2
Elmira	45,106	51,972	309	194	4.3
Jamestown	42,638	110,686	399	149	3.4
Kingston	28,589	28,966d	321	168	6 0
Mount Vernon	67,362	55,609	479	185	2.7
Newburgh	31,883	82,179	199	117	3.6
New Rochelle	58,408	40,249	470	221	3.8
New York City	7,454,995	9,637,375	28,413	16,951	2.2
Niagara Falls	78,029	73,285	491	229	2.9
Poughkeepsie	40,478	24,592	374	144	3.6
Rochester	324,975	358,827	2,493	799	2.4
Rome	34,214	100,468	289	165	4.8
Schenectady	87,549	81,225	702	238	2.7
Syracuse	205,967	146,190	1,243	534	2.6
Troy	70,304	117,432	869	587	8.4
Utica	100,518	115,090	573	283	2.8
Watertown	33,385	102,161	305	140	4.2
White Plains	40,327	68,864	402	124	3.1
Yonkers	142,598	362,021	1,288	553	3.9
North Carolina					
Asheville	51,310	16,884	673	35	6.9
Charlotte	100,899	182,492	1,789	833	8.2
Durham	60,195	39,489	473	176	2.9
Greensboro	59,319	74,740	635	186	3.1
High Point	38,495	29,767	507	214	5.6
Raleigh	46,897	16,789	578	206	4.4
Rocky Mount	25,568	36,552	194	107	4.3
Wilmington	33,407	64,897	548	412	12.5
Winston-Salem	79,815	148,501	829	149	1.8
North Dakota					
Fargo	32,580	60,744	213	125	3.9
Ohio					
Akron	244,791	263,129	1,964	869	3.5
Canton	108,401	208,349	639	231	2.1
Cincinnati	455,610	649,058	4,483	1,578	3.4
Cleveland	878,336	1,159,766	7,972	2,417	2.7
Cleveland Heights	54,992	53,148	594	115	2.1
Columbus	306,087	396,664	3,912	1,657	5.4
Dayton	210,718	336,500	2,610	2,022	9.6
East Cleveland	39,495	26,468	236	89	2.3
Elyria	25,120	111,738	172	79	3.1
Hamilton	50,592	108,796	661	390	7.6
Lakewood	69,160	28,916	207	87	1.2
Lima	44,711	29,684	494	393	8.7

d. Insurance loss only.

City	1940 Population	Total Loss	No. Alarms	No. Bldg. Fires	Bldg. Fires per 1000 Population
Ohio (Cont'd)					
Lorain	44,125	37,537	390	106	2.4
Mansfield	37,154	13,319	248	143	3.9
Marion	30,817	182,462	313	176	5.7
Massillon	26,644	27,660	118	46	1.7
Middletown	31,220	158,328	372	195	6.3
Newark	31,487	23,418	322	118	3.8
Norwood	34,010	14,461	148	107	3.1
Portsmouth	40,466	13,289	379	198	4.9
Springfield	70,662	94,285	818	494	6.9
Steubenville	37,651	78,841	349	175	4.7
Toledo	282,349	370,405	2,484	1,222	4.3
Warren	42,837	17,725	396	192	4.5
Youngstown	167,720	251,326	1,345	723	4.3
Zanesville	37,500	31,997	487	149	4.0
Oklahoma					
Enid	28,801	24,589	355	127	4.5
Muskogee	32,332	26,994	708	351	10.9
Oklahoma City	204,424	172,368	2,767	622	3.0
Tulsa	142,157	198,956	2,701	557	3.9
Oregon					
Portland	305,394	450,561f	4,740	3,369	11.1
Salem	30,908	70,418	372	321	10.3
Pennsylvania					
Aliquippa	27,023	25,441	141	46	1.7
Allentown	96,904	46,014	350	253	2.6
Altoona	80,214	24,695	623	610	7.6
Bethlehem	58,490	149,500	41	19	0.3
Chester	59,285	70,082	370	197	3.3
Easton	33,589	13,355	176	99	3.0
Erie	116,955	42,475	883	415	3.5
Harrisburg	83,893	202,623	471	237	2.8
Hazelton	38,009	91,831	115	73	1.9
Johnstown	66,668	13,785	732	422	6.4
Lancaster	61,345	25,523	284	81	1.3
Lebanon	27,206	2,341	50	20	0.7
McKeesport	55,355	60,800	382	151	2.7
New Castle	47,638	29,659	365	167	3.5
Norristown	38,181	5,858	119	84	2.2
Philadelphia	1,931,334	2,605,936	10,462	4,001	2.0
Pittsburgh	671,659	628,516	5,019	2,409	3.6
Reading	110,568	81,360	434	132	1.2
Scranton	140,404	128,073	713	280	2.0
Sharon	25,622	15,452	217	39	1.5
Washington	26,166	33,744	308	157	6.0

f. Change in fiscal year—13 months.

City	1940 Population	Total Loss	No. Alarms	No. Bldg. Fires	Bldg. Fires per 1000 Population
Pennsylvania (Cont'd)					
Wilkes-Barre	86,236	118,360	430	191	2.2
Wilkinsburg	29,853	7,325	177	89	2.9
Williamsport	44,355	317,602	260	145	3.3
York	56,712	157,487	242	223	3.9
Rhode Island					
Central Falls	25,121	33,492	199	108	4.3
Cranston	47,173	64,145	672	106	2.2
East Providence	32,093	53,113	660	126	3.9
Newport	30,402	100,149	288	226	7.5
Pawtucket	75,449	134,147	995	262	3.5
Providence	253,214	413,691	3,199	645	2.5
Woonsocket	49,204	245,973	537	193	3.9
South Carolina					
Charleston	71,275	85,626	854	495	7.0
Columbia	62,396	80,530	806	431	6.9
Greenville	34,734	76,141	466	234	6.7
Spartanburg	32,249	71,111	481	271	8.5
South Dakota					
Sioux Falls	40,832	17,519	388	118	2.9
Tennessee					
Chattanooga	128,163	472,044	1,430	600	4.7
Johnson City	25,353	6,420	316	102	4.0
Knoxville	111,580	170,371	1,396	579	5.2
Memphis	292,942	550,000d	3,602	1,290	4.4
Nashville	167,402	228,774	3,300	939	5.6
Texas					
Abilene	26,612	47,109	....	....	....
Amarillo	51,686	54,000	513	184	3.5
Austin	87,930	96,960	1,246	367	4.2
Beaumont	59,061	48,000	886	778	13.2
Corpus Christi	57,301	38,260	503	216	3.8
Dallas	294,734	1,120,205	4,502	771	2.6
El Paso	96,810	46,750	....	....	....
Fort Worth	177,662	382,785	3,234	967	5.4
Galveston	60,862	55,128	557	256	4.2
Houston	384,514	912,689	4,792	1,567	4.0
Laredo	39,274	7,133	162	82	2.1
Lubbock	31,853	14,728	201	125	3.9
Port Arthur	46,140	37,000	265	45	0.9
San Angelo	25,802	60,875	286	94	3.6
San Antonio	253,854	189,079	1,958	722	2.8
Tyler	28,279	131,486	563	114	4.1
Waco	55,982	175,762	643	290	4.8
Wichita Falls	45,112	107,369	....	....	....

d. Insurance loss only.

City	1940 Population	Total Loss	No. Alarms	No. Bldg. Fires	Bldg. Fires per 1000 Population
Utah					
Ogden	43,688	24,814	669	172	3.9
Salt Lake City	149,934	165,631	1,603	563	3.7
Vermont					
Burlington	27,686	303,721	503	323	11.9
Virginia					
Alexandria	33,523	....	....	....	....
Danville	32,749	80,783	278	154	4.6
Lynchburg	44,541	51,539	659	320	7.3
Newport News	37,067	6,355	629	328	8.9
Norfolk	144,332	308,648	2,652	1,277	8.8
Petersburg	30,631	15,045	282	264	8.5
Portsmouth	50,745	113,016	656	253	4.9
Richmond	193,042	124,085	2,300	1,383	7.1
Roanoke	69,287	100,108	810	704	10.2
Washington					
Bellingham	29,314	32,176	558	248	8.5
Everett	30,224	20,764	620	366	12.2
Seattle	368,302	234,816	4,489	1,549	4.2
Spokane	122,001	158,302	1,334	577	4.7
Tacoma	109,408	173,410	2,085	1,086	9.9
Yakima	27,221	155,744	268	151	5.6
West Virginia					
Charleston	67,914	46,524	715	415	6.1
Clarksburg	30,579	3,119	137	74	2.5
Huntington	78,836	85,918	960	273	3.4
Parkersburg	30,103	8,118	221	58	1.9
Wheeling	61,099	27,538	455	265	4.3
Wisconsin					
Appleton	28,436	23,389	284	156	5.6
Beloit	25,365	13,409	381	268	10.7
Eau Claire	30,745	94,167	498	225	7.2
Fond du Lac	27,209	10,749	256	200	7.4
Green Bay	46,235	93,205	493	207	4.5
Kenosha	48,765	52,088	611	276	5.6
La Crosse	42,707	34,183	402	287	6.7
Madison (to 2-7-41)	67,447	111,382	748	494	7.4
Milwaukee	587,472	663,792	4,912	3,267	5.5
Oshkosh	39,089	27,491	315	187	4.8
Racine	67,195	232,933	440	280	4.2
Sheboygan	40,638	21,308	265	232	5.6
Superior	35,136	205,636	450	234	6.7
Wausau	27,268	12,321	498	329	12.2
Wauwatosa	27,769	16,437	192	103	3.7
West Allis	36,364	17,336	273	75	2.1
Total	52,069,212	80,063,460	478,746	207,192	

1940 Fire Losses, Canadian Cities.

City	Population	Total Loss	No. Alarms	No. Bldg. Fires	Bldg. Fires per 1000 Population
Alberta					
Calgary	84,000	$71,617	365	75	0.9
Edmonton	79,000	412,328	685	329	4.1
British Columbia					
Vancouver	247,000	227,179	2,547	492	1.9
Victoria	39,000	13,582	471	270	6.9
Manitoba					
Winnipeg	219,000	228,757	3,604	2,229	10.1
New Brunswick					
St. John	48,000	128,000	766	228	4.7
Nova Scotia					
Halifax	59,000	133,861	782	600	10.2
Ontario					
Brantford	32,000	167,740	240	114	3.6
Fort William	26,000	52,777	418	282	10.8
Hamilton	156,000	279,432	956	555	3.5
Kitchener	31,000	8,809	148	57	1.8
London	71,000	89,553	499	306	4.3
Ottawa	127,000	294,446	1,978	1,267	9.9
St. Catharines	25,000	40,930	190	119	4.7
Sault Ste. Marie	25,383	24,875	293	155	6.2
Toronto	631,207	1,074,484	4,041	1,539	2.4
Windsor	63,000	250,000a	732	174	2.7
Quebec					
Hull	29,000	22,306	864	....	....
Montreal	819,000	1,540,104	6,678	2,081	2.5
Quebec	131,000	416,947	2,738	1,870	14.3
Sherbrooke	29,000	66,118	705	324	11.2
Three Rivers	35,000	40,119	530	444	12.7
Saskatchewan					
Regina	53,000	143,027a	405	255	4.8
Saskatoon	43,000	26,883	424	235	5.4
Total	3,101,590	5,753,874	31,059	14,000	

a. Estimated.

Type "S" Fuses.

Fuses, often referred to as the "safety valves" of electrical systems, must be properly used if they are to perform their function of "blowing" to interrupt the current and prevent fires due to short circuits or electrical overloads. Fuses of the proper ampere rating must be used for the individual circuit, and above all, they must not be bridged.

Attention of the N.F.P.A. has focused on the fuse problem for many years, and in 1933, when newspapers and periodicals all over the country reported that inspectors had found bushels of coins used to bridge fuses and that an alarming number of electrical fires were being caused by this and other such condemnable methods, the N.F.P.A. Electrical Committee went into action.

The "Non-Tamperable" Fuse, 1933-37.

The Committee tried to remedy the situation first by permitting the use of an approved "non-tamperable" fuse in place of the standard type which had long been recognized by the National Electrical Code. This "non-tamperable" fuse was to plug into a cutout base and was to be constructed according to the following specifications as stated in the 1933 National Electrical Code.

1. Plug fuses may be rendered non-tamperable either by the use of an adapter in a standard plug fuse cutout base or by the use of a special cutout base. Non-tamperable plug fuses of the 16-25 ampere classification shall not be usable with the special bases or adapters for non-tamperable fuses of the 0-15 ampere classification.

2. They shall be of such a type and so designed as to be subject to tampering or bridging only with difficulty.

3. When installed and fully assembled they shall have no live parts exposed.

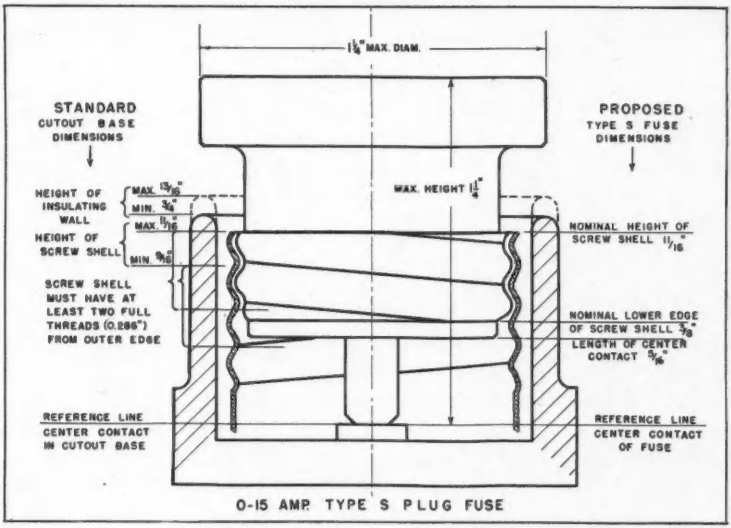
4. The adapter used with this fuse must be so designed that once inserted into the cutout base it cannot be removed.

5. The adapter and the non-tamperable cutout base shall be of such design as to be capable of receiving only a fuse plug constructed to the above specifications.

6. Fuses, bases and adapters of various manufacturers shall be interchangeable with each other.

In 1935, the committee took more drastic action to put a stop to fuse tampering. It was written into the 1935 National Electrical Code that cutout bases for "non-tamperable" fuses of 30 amperes or less must be installed beginning July 1, 1937. Specifications for the "non-tamperable" fuses remained unchanged with the exception of a change in classification. The 16-25 ampere classification became 16-30 amperes.

Before July 1, 1937, however, the code was amended.


1 1/8" MAX. DIAM.
STANDARD CUTOUT BASE DIMENSIONS
PROPOSED TYPE S FUSE DIMENSIONS
HEIGHT OF INSULATING WALL
MAX. 13/16"
MIN. 3/4"
HEIGHT OF SCREW SHELL
MAX. 11/16"
MIN. 9/16"
MAX. HEIGHT 1 1/4"
NOMINAL HEIGHT OF SCREW SHELL 11/16"
SCREW SHELL MUST HAVE AT LEAST TWO FULL THREADS (0.286") FROM OUTER EDGE
NOMINAL LOWER EDGE OF SCREW SHELL 3/8"
LENGTH OF CENTER CONTACT 5/16"
REFERENCE LINE CENTER CONTACT IN CUTOUT BASE
REFERENCE LINE CENTER CONTACT OF FUSE
0-15 AMP. TYPE S PLUG FUSE

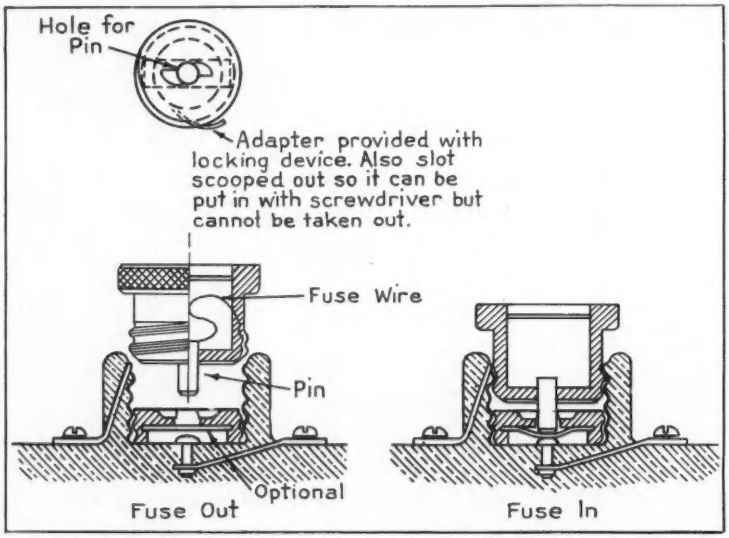
It appeared that "non-tamperable" fuse specifications in the 1933 and 1935 codes had been introduced before industrial research could produce designs considered acceptable to the "non-tamperable" feature of the requirement. When such types of fuses finally were developed they were non-interchangeable among the various manufacturers because of patent rights.

At once there was conflict. To require "non-tamperable" fuses would tend to aid in the creation of a monopoly in the manufacture of "non-tamperable" fuses. If such fuses were required, and other "non-tamperable" fuses were developed by manufacturers, the fuses and cutout bases would not be interchangeable among the various manufacturers, with resultant confusion and inconvenience to the public. Consequently, the 1937 code *recommended* but did not require the use of "non-tamperable" plug fuses which were not interchangeable but which were in accordance with the other features listed in the 1933 and 1935 codes.

Standard of the Special Committee.

In 1939 and 1940 the problem of interchangeability remained unsolved, and in an effort to alleviate the trouble a special committee was appointed to determine a standard for "non-tamperable" fuses, now termed Type "S" fuses, since it had been agreed upon that no fuse could be 100% "non-tamperable."

The special committee has now prepared its report to be presented to the N.F.P.A. Electrical Committee in June. The work of this special committee and the standard Type "S" fuse proposed by that committee are presented herewith.


Hole for Pin
Adapter provided with locking device. Also slot scooped out so it can be put in with screwdriver but cannot be taken out.
Fuse Wire
Pin
Optional
Fuse Out
Fuse In

The proposed standard Type "S" fuse in and out of cutout base, and showing top elevation.

The committee decided that the proposed standard should meet all of the following requirements if possible.

1. All features required by previous codes.
2. The maximum tamper-resisting feature that it was practicable to obtain.
3. Usability in the Edison fuse holder with or without an adapter.
4. Desirability that the presence of the adapter be evident without removing the fuse.
5. Dimensions such as to permit general use with existing equipment (cutout boxes, service equipment, panel boards, etc.).

The committee found that it would be impossible to meet all of these requirements in setting a standard. The inclusion of some conflicted with the inclusion of others. What was sought, finally, was a standard Type "S" fuse in which each of the requirements would be balanced as evenly as possible and permitting the inclusion of each to some, if not to its fullest, extent.

The proposed standard finally arrived at by the committee has as its principal features the following:

1. Interchangeability between fuses of various manufacturers.
2. Usability in an Edison base with or without an adapter.
3. Co-ordination of the use of sizes. Type "S" fuses of the 16-30-ampere classification can not be used with 0-15 ampere classification adapters. How-

ever, 0-15 ampere fuses may be used with 16-30 ampere adapters. This is accomplished by regulating the size of the fuse pin and the pinholder in the adapter. In the 0-15 ampere classification fuse, the pin is 3/16 in. in diameter and 5/16 in. long. In the 30-ampere classification fuse the pin is ¼ in. in diameter and ¼ in. long. Adapter pin holes are of the same dimensions.

4. Bridging is made reasonably difficult.

5. Exclusion of any live part exposed to accidental contact with fuse and fuse holder either with or without adapter.

6. Dimensions such as to permit general use in existing cutouts, service equipment, panel boards, etc.

7. Considerable latitude to manufacturer as to materials, contacts, arrangements, etc. The screw shell contact can be made in a number of ways and still conform to the standard.

The special committee has devoted its best efforts to making its proposed Type "S" fuse acceptable. Nevertheless, the members of the committee still feel that there may be possible objections to their standard when it is put before the Electrical Committee of the N.F.P.A. First, it may be felt that the degree of resistance to tampering is not so great as might be desired. Modification of the requirement from "non-tamperable" to "subject to tampering and bridging with difficulty" should justify this feature the committee feels.

Second, the adapter is not visible (except in open types of cutouts, where it may be seen through terminal opening in base of cutout) or otherwise evident with fuse in place. This feature was sacrificed in favor of a fuse that would be usable in the Edison base without an adapter.

Brockton Theatre Tragedy.

By Warren Y. Kimball,
N.F.P.A. Engineer.

The worst tragedy to strike any fire department in the history of New England occurred early on the morning of March 10, 1941, when a portion of the roof of the Strand Theatre in Brockton, Mass., collapsed during a general alarm fire, killing thirteen members of the fire department and injuring seventeen more or less seriously. One-tenth of the membership of the Brockton Fire Department was killed in the disaster which wiped out or incapacitated the greater part of the platoon on duty at the time of the fire.

Construction of the Building.

This brick motion picture theatre building was erected in 1916, following a general alarm fire which destroyed its predecessor on the same site. The structure was on an irregular shaped plot, large at the auditorium end and narrowing down to the stage section. The theatre was located at the rear of a business block with a rather long lobby forming the main entrance. The building was hemmed in on three sides by other structures, making access difficult for fire fighting.

The roof over the auditorium consisted of boards on joists supported on steel trusses. The auditorium ceiling was of metal lath and plaster on wood joists and was suspended from the roof trusses. Between the roof and ceiling was a large unsprinklered air space of considerable height.

The roof over the stage section was of fire-resistive construction and the stage section was covered by a partial dry pipe sprinkler system. The stage section was not involved in the fire. There were also several sprinklers in the rest rooms located on the balcony over the rear of the auditorium. The balcony also contained the manager's office, rest rooms, and an usher's room.

The area under the auditorium floor contained a large dead air space, except for a section at the rear containing a ventilating fan and janitor's room.

Story of the Fire.

The fire is said to have been discovered by sweepers about an hour after the theatre closed for the night. The first alarm was given at 12:45 A.M. When the fire department arrived the fire had gained considerable headway in the basement where apparently it started. Due to the headway of the fire a second alarm was sounded by the deputy chief in charge of the first alarm companies. Three cellar pipes are said to have been used to control the fire in the basement. The fire department then found that the fire had extended upward from the basement, following duct spaces in the rear walls and had entered joisted

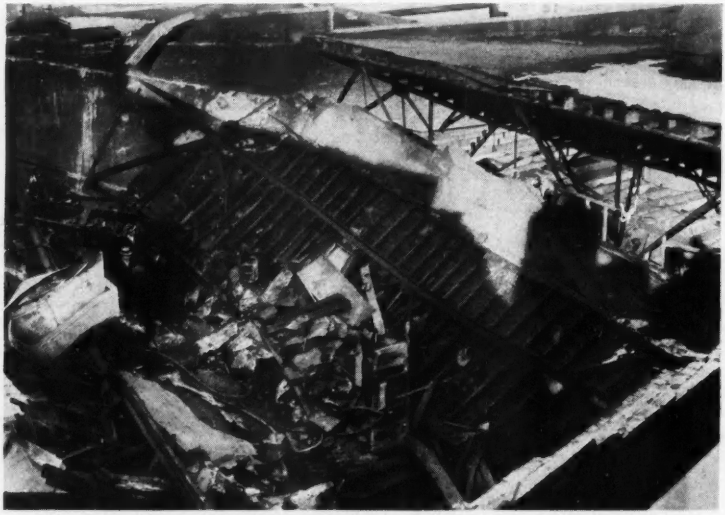
under balcony spaces. Portions of the ceiling under the balcony were pulled down and this part of the fire was controlled without serious difficulty.

When it was found that the fire had spread upward from the basement, a general alarm was sounded, bringing the entire Brockton Fire Department. The full response consisted of five engine companies (each with a separate pumper and hose wagon), three ladder companies and the squad company. Members of the off-duty platoon were also called to the fire. About fourteen hose streams were placed in operation, supplied by the pumpers. Adjoining towns sent apparatus to cover vacated stations under a mutual aid plan.

Firemen and other rescue workers on the balcony searching for victims in the débris. At the upper left are the ruins of the projection booth. The fire spread upward in duct channels at the rear of the auditorium, entering the roof space and under balcony areas. The early failure of the roof supports above the rear portion of the balcony allowed that portion of the roof structure to fall upon firemen working in the balcony.

It was soon discovered that the fire had spread upward into the rear portion of the roof space and lines were taken into the balcony to control the flames at this point. The fire department appeared to be making good progress in controlling the blaze when suddenly, without warning, the rear portion of the theatre roof collapsed upon the balcony, trapping and crushing several companies of firemen working at that point.

The collapse of the roof and a portion of the side walls cut off a number of hose streams in this area and the fire is said to have increased in intensity, making rescue efforts extremely difficult. Rescue work was further impeded by the extreme danger that a further collapse might carry down the débris laden balcony, trapping even more men with the victims they were



View of collapsed Strand Theatre from an adjoining roof shows at right the remaining steel trusses supporting the front section of the roof and ceiling, forming a large roof space. Men at the left are standing on the balcony upon which the rear portion of the roof crashed when the trusses failed, trapping the firemen.

trying to save. Fortunately rescue efforts were completed without any further disaster. It is believed that with the exception of one fireman who died in a hospital, most of the victims were instantly killed. Most of the bodies were so badly burned that identification was difficult.

Cause of the Collapse.

The collapse of the roof which resulted in the fatalities appears to have occurred when flames reached the unprotected steel trusses in the rear portion of the unsprinklered combustible roof space. The early and unanticipated collapse was undoubtedly hastened by the added weight of several inches of wet snow on the roof.

Without much doubt, this roof collapse and resultant tragedy should be attributed to failure to provide in the construction of the theatre roof a sufficient factor of safety to provide against possible failure of the roof structure when weakened by a fire of even moderate intensity at a time when the roof was carrying an additional load due to snow. This disaster is a close reminder of the Knickerbocker Theatre tragedy in Washington, D. C., in 1922, when ninety-eight lives were lost when the theatre roof collapsed due to snow load, without the contributing factor of fire.

The Brockton Fire Department has been one of the model fire departments of New England in its efficiency of operation. It is under capable leader-

Interior of the Strand Theatre at Brockton, Mass., where thirteen firemen lost their lives as a result of the collapse of the theatre roof during a general alarm fire on the morning of March 10, 1941. The picture taken from the theatre stage shows a portion of the collapsed roof resting on the balcony, from which firemen were directing hose streams into roof space when the collapse occurred without warning.

ship and has made regular inspections of all buildings in the city in an effort to be reasonably familiar with conditions that might be encountered during fires.

The Strand Theatre fire at all times prior to the collapse appeared to be localized in concealed spaces at the rear of the theatre. At no time did the blaze assume a magnitude for which outside fire fighting would have been indicated. It is extremely unfortunate that there was no advance warning to give those trapped a chance to escape. The collapse appears to have been of an instantaneous nature. Any slight rumbles or groanings that might have forewarned those inside must have been made inaudible by the usual noise of the hose streams that were in use.

As far as is known, the initial cause of the blaze has not been determined. However, the actual cause appears to have had little bearing upon the subsequent disaster. In the absence of any other apparent cause the theory was advanced that the fire may have been of incendiary origin, but no indication has been given that such a theory could be substantiated either by producing a motive or a possible suspect.

The New Orleans Warehouse Fire.

Report by H. P. Dixey and W. J. Moll,
Louisiana Rating and Fire Prevention Bureau.

A fire in Warehouse "A" of the Bienville Warehouse Corp., New Orleans, La., on the night of March 12, totally destroyed this large unsprinklered building and damaged near-by property. The loss has not been determined, owing to the diversity of ownership, but has been estimated at upwards of $1,500,000.

The fire started in a wooden box car spotted on a siding on the southeast corner of the warehouse. A watchman of the Maloney Warehouse & Trucking Company, directly across Iberville Street, was first to notice the flames and he turned in an alarm from an American District Telegraph Co. fire alarm box on the first floor of his building. This alarm was received by the A.D.T. at 8:11 P.M. and was relayed to the fire department at 8:13 P.M. When the fire department arrived at the fire, however, it had already spread into the warehouse through numerous door and window openings which were plain glass in wooden frames.

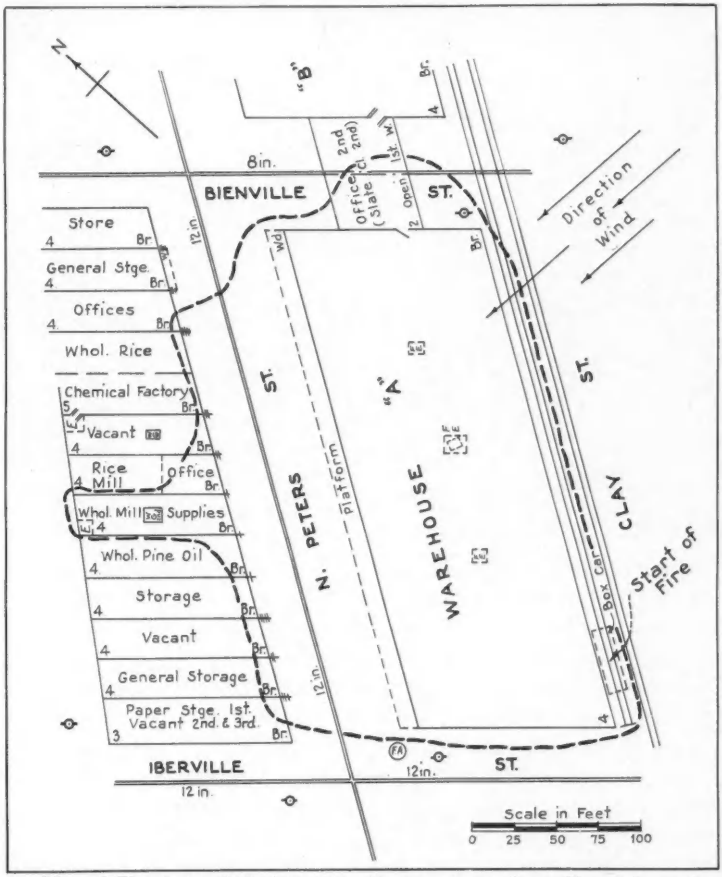
Two general alarms were immediately sounded, but there was little the fire department could do to save the structure. Less than an hour later, the south wall of the building collapsed, and the remaining walls fell shortly thereafter. Fifteen men were injured during the progress of the fire.

Building Construction and Contents.

Warehouse "A" was constructed in 1892 for railroad terminal purposes and at a later date leased to tenants for public storage. As constructed originally, the building was two stories in height. In 1898, however, two additional floors were added. The building was constructed of brick and covered an area 110 x 305 feet, or a total of 33,550 square feet. Walls were a foot thick on three sides and on the fourth side, 20 inches. They were parapeted 24 and 36 inches above the roof.

On the east side of the building where the siding was located, the brick wall began at a height of 14 feet above the level of the first floor. The weight of this brick wall above was carried by unprotected steel beams supported by unprotected steel columns on 14-foot centers. The space between columns, beams, and floor was closed by center parting wooden doors with ordinary glass windows in wood frames in the upper parts of the doors.

On the west side of the building, where the trucking platform was located, the brick wall extended to the foundations and the space between the pilasters, 11 feet square, was also enclosed by center parting wood doors with unprotected openings at the top guarded merely by heavy steel bars. Windows all through the warehouse were ordinary glass in wood frames.



Plan of Warehouse "A" of the Bienville Warehouse Corp., New Orleans, La., where fire occurred on the night of March 12. The fire originated in the box car spotted on the siding near the southeast corner of the plant and spread into the building through glass windows and wooden doors.

The peaked roof was constructed of built-up composition and shell covering on wood sheathing. The roof joists were supported by wooden trusses. The first floor of the building was concrete, but those above were of double plank and heavy joisted construction. Joists were self-releasing on all floors above the first.

Vertical openings were all frame enclosed, with self-closing doors at each floor opening. These vertical openings included an elevator, two barrel hoists, and one stairway.

Masonry walls crumpled to brick and dust under the terrific heat, and 100 hose streams had little effect on this fire that resulted in a loss of approximately $1,500,000.

An enclosed passageway connected Warehouses "A" and "B" on the second floor level over Bienville Street. Offices were located in this overpass, which was of frame construction, 42 x 66 ft., and covered on the exterior with slate. There was a non-standard tin clad fire door to Warehouse "A." Standard automatic double fire doors to Warehouse "B" prevented fire from spreading to Warehouse "B," which was of construction similar to Warehouse "A."

Story of the Fire.

The box car in which the fire started was used by the occupants of the warehouses for the disposal of trash. When it was filled, the car was hauled away.

The watchman of the Maloney Warehouse & Trucking Company across the street from Warehouse "A" was making his 8:00 P.M. rounds when he discovered the fire. He was on the second floor of the building, and after he had punched a box there at 8:08 P.M., he hurried immediately to the A.D.T. master station on the first floor.

The night watchman of the Bienville Corp. stated that he had just completed his rounds at 7:40 and had returned to his office prior to starting his 8 o'clock rounds, when he detected the odor of smoke. He went downstairs and found the first floor on fire and the fire department arriving. The fire spread so rapidly that he was unable to return to his office to get his watchclock and personal belongings. Officials of the company stated that the watchclock was destroyed in the fire and also clock dials of the previous nights.

Warehouse "A" of the Bienville Corporation at the height of the fire. The wall which was falling as this picture was taken injured several firemen. The entire warehouse was destroyed.

It was 8:16 P.M. when the fire department arrived with a truck, chemical engine, water tower and squad car. The fire from the box car had already entered the warehouse and was spreading rapidly. The entire south end of the first floor was in flames.

A general alarm was sounded and it was followed by another general alarm, bringing into service a total of 34 pumpers, three trucks, two chemical engines, two water towers, one squad wagon and 215 men. Three assistant chiefs and 121 off-duty men were also summoned to the scene by radio.

The south wall of the building collapsed about 9:05 P.M. and the remaining walls fell shortly thereafter. The woodwork in the walls of several brick buildings across N. Peters St. was ignited and three of the buildings were damaged severely by fire and water. The loss to nine others was slight.

About 11:30 P.M., the fire was brought under control, but six pumpers remained until the following morning, wetting down the smouldering ruins. Four pumpers were in service until March 15, when hose was connected directly to hydrants. Firemen remained on duty as a precautionary measure.

At the height of the fire, 100 hose streams were in action and there was always sufficient pressure. Nevertheless, all efforts to save the warehouse were fruitless. At the time of the fire, a nine-mile an hour wind was blowing from the east and it was raining. The temperature was 50 degrees.

The day after the fire. Firemen are still wetting the smouldering ruins to prevent another outbreak of fire. In the upper right can be seen a remaining portion of the overpass connecting Warehouse "B" and Warehouse "A."

Extent of Damage.

Warehouse "A" was totally destroyed and from appearances there will be little, if any, salvage of the contents. The value of the contents in storage is not yet available, but it is estimated at $1,375,000. The building loss involved approximated $125,000. The extent of the loss to the buildings on the west side of N. Peters St. is not ascertainable at this time.

Conclusions.

The practice of spotting box cars near buildings as receptacles for trash and sweepings is hazardous and sometimes very costly, as this fire has proved.

The fire in the box car could have been caused by spontaneous ignition. More likely it was careless smoking.

Wood doors and frame windows with ordinary glass were of no value in retarding the entrance of fire into the building. Once the fire had entered the building, the large area with barred openings in the doors along the west side of the first floor was conducive to the rapid spread of the fire. A building of this size with large contents value should have been provided with fire walls which would have probably limited the loss to one section.

There was only one watchman to cover both Warehouses "A" and "B," exceptionally large areas and high value. Had there been a watchman for each building and had each been required to remain in his respective building, it is

probable that the fire would have been detected soon enough to prevent such serious damage. Excellent work by the fire department prevented a general conflagration on the west side of N. Peters St.

The most undesirable feature of this warehouse, however, was its lack of sprinkler protection. Complete automatic sprinkler protection is generally the most suitable means of protecting buildings of large area without fire-resistive walls and partitions, and constructed of combustible materials.

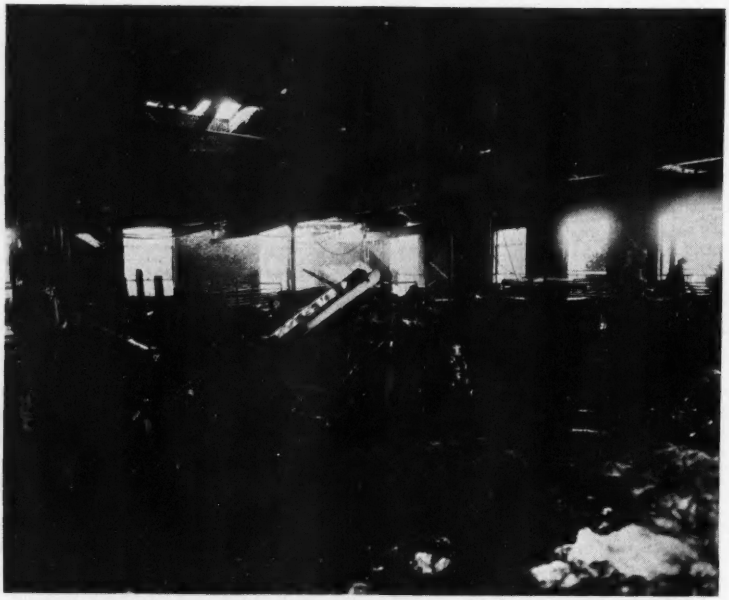
New Haven Quilt and Pad Co. Fire.

By Robert S. Moulton,
Technical Secretary, N.F.P.A.

Ten men were burned to death and three injured by jumping from third-story windows in a fire in the New Haven Quilt and Pad Co., New Haven, Conn., shortly after 2 A.M. on February 5, 1941. This fire is of particular interest because the loss of life occurred in a sprinklered building, with two exits in the section involved, and with more than the usual complement of hand fire extinguishing equipment. The fatalities were due to a closed sprinkler valve, failure of the employees to leave the fire area promptly, and ill-advised attempts to fight the fire without calling the New Haven fire department.

The New Haven Quilt and Pad Co., operated by David H. Levine and Edward I. Levine, was making quilts for the U. S. Army. At the time of the fire deliveries were in arrears and the concern was paying a penalty for not filling the orders within the specified contract time. There was also an unofficial report that a quantity of quilts had been rejected because of underweight. The coroner found, however, no evidence that the sprinkler valve had been shut by the owners, and stated that even if it should appear that the owners or their agents had shut off the sprinkler system it would not be a crime under the present Connecticut laws. There had been thirteen previous reported fires in this factory, with losses ranging from slight to a $20,000 loss in 1929. The coroner suggested in his report that since the record of previous fires showed that the water loss was much greater than the loss from the fire itself, the owners might have wished to prevent unnecessary water damage by turning off the sprinkler system and extinguishing fires with hand equipment. The last two reported fires were in cotton pickers, one on October 21, 1940, when 19 sprinklers opened and extinguished the fire with a loss of $4000, and the other on January 11, 1941, with a loss of $200.

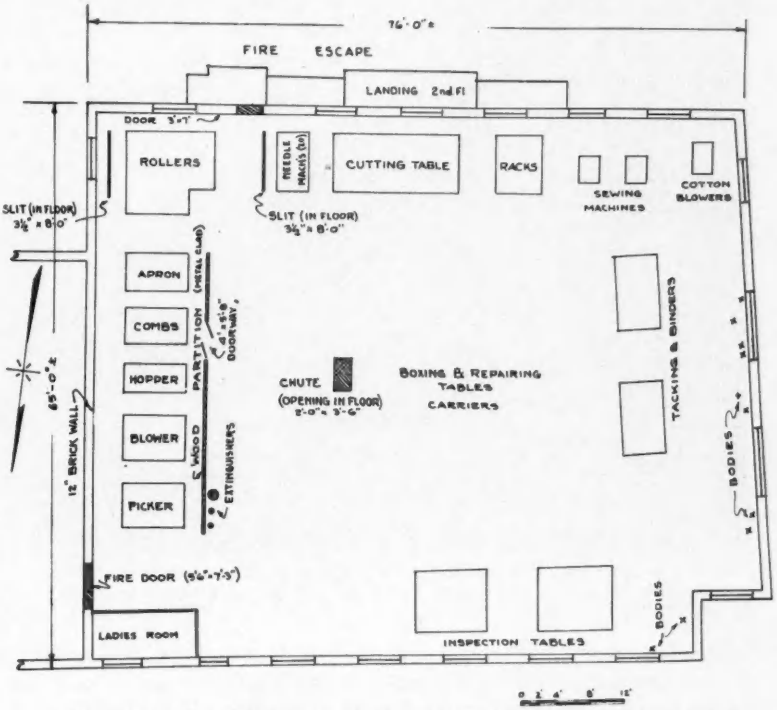
This report is based upon an inspection by the writer with the coöperation of Paul P. Heinz (member N.F.P.A.), Chief of the New Haven Fire Department, a report by Lieut. Gene S. Lenzi of the Connecticut State Police, acting as Deputy State Fire Marshal, a report from the Eastern Underwriters Inspection Bureau (member N.F.P.A.), the report of Coroner James J. Corrigan, and data from other sources. The plan and photographs have been furnished by the Connecticut State Police.



Interior of the room after the fire, showing congestion of machinery and contents. Note carbon dioxide extinguisher in the center.

After the fire of January 11 the sprinkler control valve was sealed open by an insurance inspector and on the day following that sealing, the valve was examined by an inspector of another fire insurance organization and was noted as open and properly sealed. However, during the fire the valve was found closed, with the seal apparently intact and in place. After the fire the seal was so damaged and mutilated that it was impossible to determine whether it had been tampered with or not. The coroner's report showed that the valve was near a basement washroom accessible to all employees and to outsiders who might have entered unnoticed. The valve itself was of the old-fashioned target variety, and it would have been possible by removing the hand wheel to close the valve without breaking the seal. The circumstances at least suggest that an attempt was made by persons unknown to conceal the fact that the water was shut off from the sprinkler system.

The arrangement of the third floor of the rear section where this fire occurred is shown by the accompanying diagram. The building was a three-story brick structure with timber floors on steel girders, erected in 1933. There was originally a stairway in the center of the room. This was later converted into a chute, which, however, did not prove practical and the opening was floored over at this point.

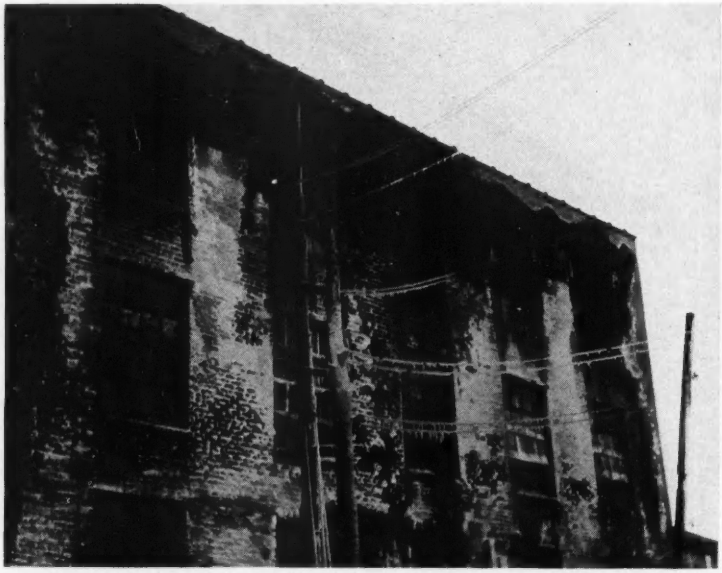


Plan of the third floor of the rear section of the New Haven Quilt and Pad Co., where 10 men were burned to death on February 5, 1941.

Bales of cotton were brought in through the fire door at the northeast corner. After passing through the machinery on the east wall, the cotton was rolled up in batting at the southeast corner. At this point cotton sheeting was brought up through slits in the floor on both sides of the cotton batting to form a cover for the quilts. A needle machine stitched the covering and filling together, after which the quilts passed to the cutting table and various other operations were performed.

Reports indicate that cotton flyings accumulated in some quantity around the room and that the metal-clad partial partition screening the picker and associated machinery from the balance of the room did not prevent the spread of the cotton flyings throughout the room.

In addition to the dry pipe sprinkler system with some 50 heads in this room, first aid fire protection was provided for the picker by two hand hose lines with spray nozzles of the garden hose type. One or more 50 lb. carbon dioxide extinguishers and a wheeled soda-acid extinguisher were provided.



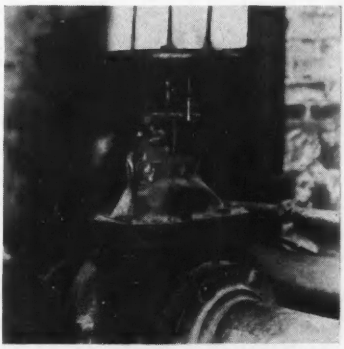
The north wall of the building, where three men were injured in jumping from the third-story windows. In the darkness and confusion they did not see the poles which they might have climbed down.

In an adjoining room a similar picker unit was also protected with a carbon dioxide hand hose reel which, it is reported, was brought through the fire door and used on this fire. The presence of such an amount of hand extinguishing equipment suggests the possibility that picker fires were perhaps more frequent than indicated by the reported losses and that perhaps it had been a relatively frequent occurrence to have such fires extinguished without reporting them to the fire department or to the insurance companies. There is, however, no definite evidence on this point. There is also no evidence as to the reason for providing carbon dioxide extinguishing equipment, which is not recommended for this type of hazard.

The Fire.

On the night of the fire the night shift comprising 26 men in this room had returned to work after the lunch hour period at 2 A.M., when the fire started in or near the picker. This fire was discovered by an employee at about 2:12 A.M. As had been customary in previous fires, employees attempted to extinguish the fire with hand extinguishers. Other employees from various parts of the factory came to the fire door and also attempted to fight the fire with extinguishers and hand hose lines. In the meantime some men had left the room and others had moved back towards the westerly wall, apparently under

the impression that the fire would soon be brought under control and perhaps relying for their safety upon the sprinklers which had operated successfully in previous fires.



The Closed Sprinkler Valve. There was central station supervisory service for the air pressure on the sprinkler system, and central station connection for the water flow alarm, but no supervision of this main shut-off valve.

As is usual after any such disaster where many of the men involved lose their lives, there is conflicting testimony and it is difficult to establish with certainty the exact sequence of events. There were reports that the employees did not take the fire seriously and that there was some "horse play" in the fire operations which, however, were not substantiated in the coroner's inquest. In any event, it is clear that the fire did not spread dangerously for some appreciable time and that if the employees had left promptly upon the discovery of the fire there would have been ample time for them all to leave the room without danger.

The fire spread behind the partition and after a few minutes flashed out at both ends, cutting off access to both the fire door into the adjoining section and the fire escape. The continued operation of the blower, which could not be reached to shut down, was a factor in the rapid spread of the fire. As the fire suddenly spread, those near enough to the fire door to do so rushed from the room. One survivor states that he was able to reach the fire door through the flames under the protection of the water spray from a hose line operated by another employee through the fire door. This statement tends to refute rumors that the standpipe lines supplying the hand hose were also shut off in the basement. Reports agree that there was some difficulty with the hand hose lines provided for the protection of the picker, but owing to the presence of other fire fighting equipment, it was not clear that this had any material bearing upon the result.

At the moment when the fire flashed and the employees rushed from the fire door there was some congestion owing to the presence of other employees standing in or near the fire door opening. Bales of cotton restricted access to the doorway, but did not block it. A foreman was bringing up a wheeled extinguisher at this time and this was also said to have interfered with the escape, but it is not stated that any employees were thereby actually prevented from getting out.

Quickly the entire room became a mass of flame. Employees, probably not realizing that there was anyone left in the room, closed the fire door, thus

preventing the spread of fire into the adjoining section. This was about five minutes after the start of the fire.

No one had thought to call the fire department until occupants of near-by dwellings were aroused by the flames and telephoned the fire department at 2:17 A.M. A street box was also operated. The fire department responded promptly, arriving at about 2:20 A.M., but even when the alarm was first given it was already too late for rescue operations.

Three of the employees escaped by jumping from the windows on the north wall. These men suffered various degrees of injury, but all survived. Why others did not attempt to jump from windows is not explained. The bodies were all found near the windows, as shown on the plan. The windows were of the tilting factory type which might have made it more difficult to get through than windows of ordinary type with a larger area of opening, but the three men who did escape by way of windows did not mention any particular difficulty owing to the window design, and the presumption is that those who perished were overcome before they could attempt to get through the windows. The autopsies showed that the deaths were due to suffocation by smoke, carbon monoxide poisoning and burns of the body.

The American District Telegraph Co. received a low air pressure signal at 2:15 A.M. and dispatched a runner to the plant. When he arrived at 2:23 A.M. the fire department was in charge. A water flow alarm was received at 2:37 A.M. It appears that employees opened the sprinkler shut-off valve at this time but were alarmed by the noise of the rush of water and closed it again.

The New Haven Fire Department fought the fire with hand hose lines and deck guns. Additional companies were brought in by second and third alarms. The fire was confined to the third floor of the section involved, with water damage on lower floors. There is no report of the amount of the loss, but it was obviously considerable.

* * * * *

On March 5, just a month later, another fire occurred in this factory. General overhauling, repairing operations and work on providing safeguards were under way, but regular manufacturing operations had not been resumed. Two men were at work stuffing strips of cotton felt into rejected quilts to bring them up to the proper weight. An electrically operated hand cutter in some way severed its electric supply cord and the resultant arc ignited the cotton. One sprinkler opened and quickly extinguished the fire.

Airplane Hangar Fire Record.

Airport facilities are of vital importance to any nation interested in air defense and air supremacy. Well known by fire protection authorities is the fact that airplane hangars are especially vulnerable to fire damage unless provided with strong private protection. Due to the nature of the occupancy, public protection alone has seldom proved adequate to prevent extensive losses when fires have occurred. Hangars are structures of large area and high roofs and are frequently of inferior construction.

From a fire protection standpoint, the occupancy hazards of an airplane hangar are generally conceded to be quite severe. To the combustibility of airplanes, often closely spaced when housed in hangars, are added the hazards of gasoline, welding torches, and other hazards found in repair shops, garages, or other similar occupancies.

This airplane hangar fire record represents a study of 79 fires reported to the N.F.P.A. Department of Fire Record since January 1, 1931, and supplements the airplane hangar fire record published in the April 1930 QUARTERLY. This record must be considered to present a typical rather than a complete fire record experience, as there have doubtless been many small fires in airplane hangars during the past ten years for which no reports have been made through usual channels.

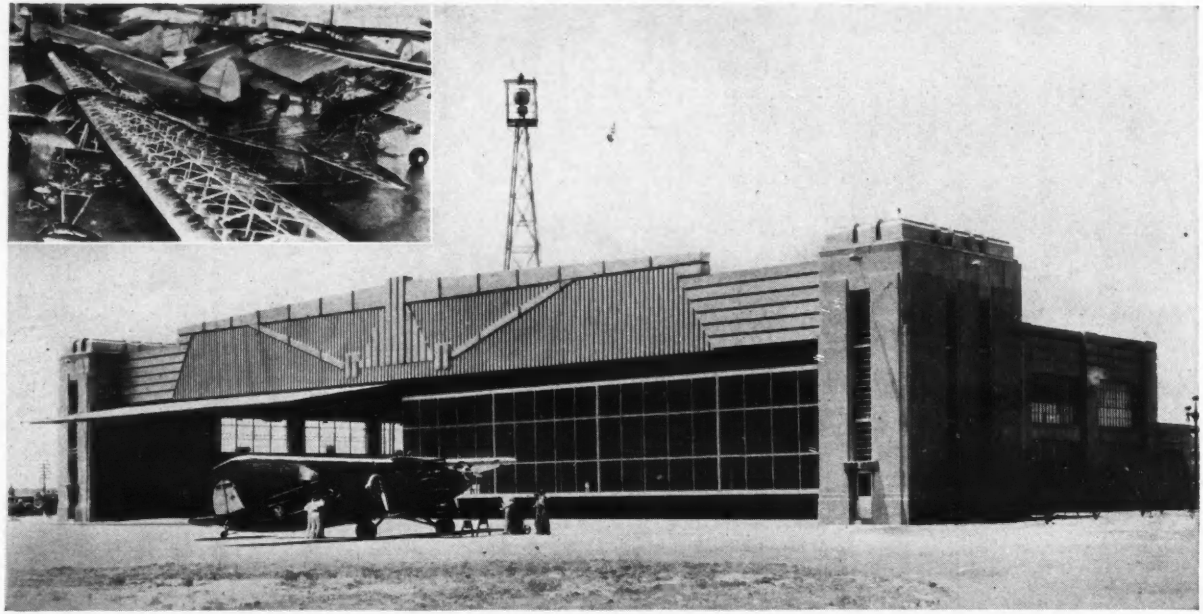
The following table gives the causes of the various airplane hangar fires included in this record. It will be noted that 51 of the 79 fires were due to special occupancy hazards.

Causes of Airplane Hangar Fires.

1931 to 1940 inclusive.

Common Hazards

	No. Fires	Total
Heating Appliances		5
Overheated stove or furnace	3	
Oil furnace explosion or backfire	2	
Miscellaneous Common Hazards		8
Incendiary—suspicious	4	
Electric drill	1	
Exposure—grass fire	1	
Lightning	1	
Rubbish	1	
Total common hazard fires		13
Unknown causes		15



The Shushan Airport, New Orleans, which is equipped with a deluge type sprinkler system and rate-of-rise control. The value of this equipment was proved when fire broke out on the freshly doped fabric of one of the 32 planes housed in the hangar. The sprinklers controlled the fire with a loss of only $1700. Damage is shown in the insert.

Causes of Airplane Hangar Fires (Cont'd)

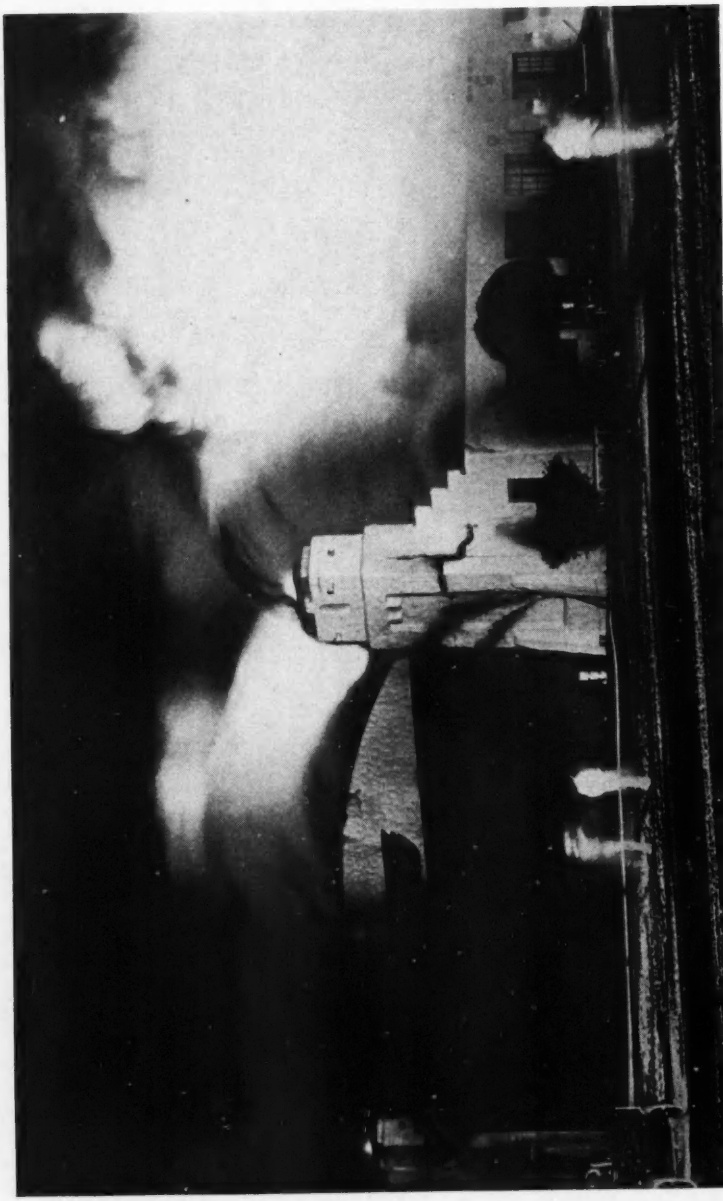
Special Hazards.

	No. Fires	Total
Ignition of Flammable Liquids and Vapors		20
Extension light ignited doped fabric	3	
Gasoline vapor ignited—miscellaneous	3	
Spark from switch at gasoline pump	3	
Extension light ignited gasoline	2	
Gasoline vapor at sump pit	2	
Short circuit at gasoline pump	2	
Cleaning plane with gasoline	1	
Gasoline placed on stove	1	
Gasoline vapor ignited—friction	1	
Gasoline vapor ignited—static	1	
Gasoline vapor ignited by coal stove	1	
Welding		5
Spark from welders' torch	3	
Acetylene torch ignited planes	2	
Spray Finishing or Dope		2
Dope ignited by electric stove	1	
Explosion in spray room	1	
Miscellaneous Special Hazards		8
Short circuit in airplane wiring	4	
Detonation of parachute flare	1	
Explosion—plumber's pot warming motor	1	
Heating oil on stove—explosion	1	
Heating wax on stove	1	
Unknown in airplanes		16
Total special hazard fires		51
Total		79

Complete information regarding the construction of all hangars involved in this fire record is not available, but it is known that eleven of the hangars were of frame construction and three were of sheet metal construction. With the exception of three hangars definitely classed as of fire-resistive construction, many of the remainder were of brick, concrete or hollow tile construction, frequently having roof structures supported by unprotected steel members.

Losses in Hangar Fires.

Of the hangar fires included in this record, 79, or 56 per cent, involved losses in excess of $5000 or "large." None of these large losses occurred in hangars protected by automatic sprinklers. One of the largest losses was in a nearly completed hangar in which sprinklers were being installed but were not ready for service. The breakdown of the losses between sprinklered and non-sprinklered hangars is given in the next table.



Fire sweeps through this hangar at the Miami Municipal Airport. Among the destroyed planes within the structure were an experimental Seversky pursuit ship valued at $250,000 and a Lockheed "Electra" valued at $120,000. Total loss, $500,000.

Losses to Hangars and Contents.

1931 to 1940 inclusive.

	Sprinklered	Non-Sprinklered
No loss	1	1
"Small" or under $1000	3	12
"Moderate" or $1000 to $5000	4	8
$5000 to $25,000	0	16
$25,000 to $100,000	0	17
Over $100,000	0	9
"Large," no exact figure	0	2
No data as to loss	0	6
Total	8	71

Planes Destroyed.

In 34 of the 79 fires in this record, a total of 147 airplanes are reported to have been destroyed. In seven fire reports, there were no data as to any loss of planes, while in 38 fires no planes were destroyed, although some planes may have suffered damage insufficient to have been classified as "destroyed." It is interesting to observe that only one plane is known to have been destroyed in a sprinklered hangar.

Fires in Sprinklered Hangars.

Eight of the fires in this record occurred in hangars having automatic sprinkler protection. Another fire occurred in a hangar in which sprinkler piping was being installed but was not yet in service. The following brief summaries cover the nine hangar fires in this record in which sprinkler protection was in any way involved.

BOSTON, MASS., FEBRUARY 16, 1931. An employee was using an acetylene welding torch to repair a tail skid when the doped cloth of the fuselage was ignited. Workmen seized three soda-acid extinguishers and turned them on the fire. By the time the three extinguishers had been emptied, three sprinklers directly over the plane had opened. Undoubtedly this flow of water prevented fire from spreading to wings being repaired near by. Four more extinguishers were used before fire was extinguished. Loss was small.

DETROIT, MICH., DECEMBER 1, 1931. A mechanic dropped an extension cord and the attached light bulb broke against a bucket containing gasoline. The gasoline ignited and the bucket was kicked from under a plane. The heat operated a deluge valve controlling sprinklers which practically extinguished the fire. One employee rushed for a foam extinguisher 125 feet distant and this was used to complete the extinguishment. No loss resulted.

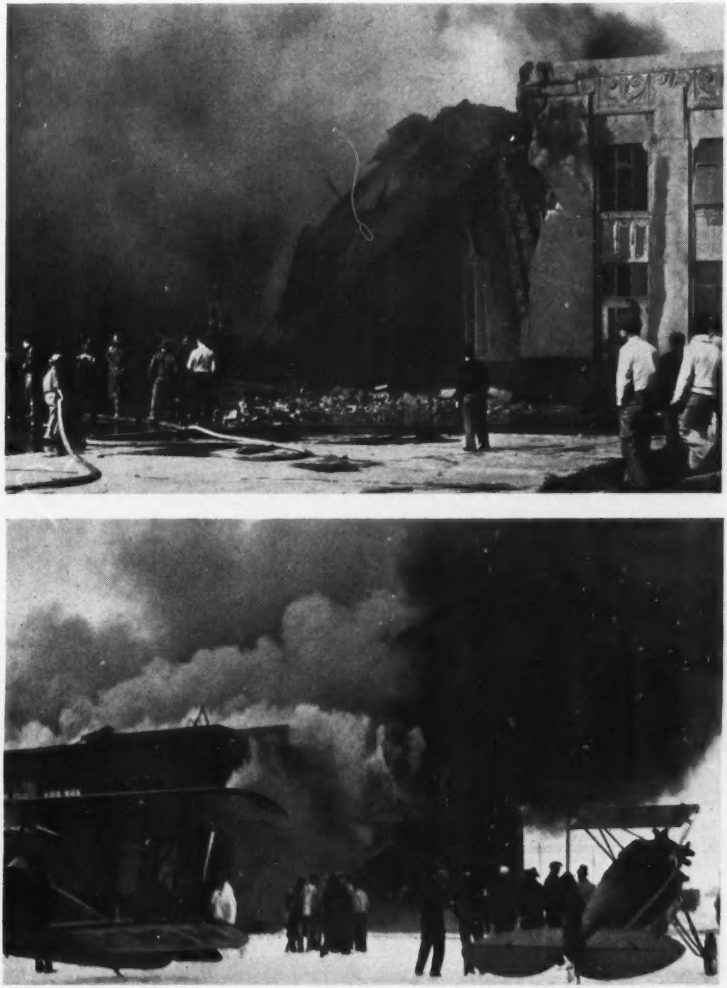
BOSTON, MASS., JUNE 9, 1932. An airplane motor caught fire apparently from a short circuit of the ignition wires. Twenty-six sprinkler heads on a dry-pipe system operated and confined the fire to the one plane which was destroyed.

CHICAGO, ILL., SEPTEMBER 22, 1933. The careless handling of gasoline resulted in its ignition. The fire was extinguished by sprinklers with small loss. A foam extinguisher was also used.

Roosevelt Field, Long Island, has had its share of fires. Top, ruins of wooden hangar following a devastating night fire. Contents of this hangar were also a complete loss. Below, interior of a fire-resistive hangar at Roosevelt Field following another fire. Ten planes were destroyed this time.

NEWARK, N. J., MARCH 20, 1934. One employee was killed and another was seriously burned by a gasoline explosion in the repair shop of a hangar. The resulting fire was promptly extinguished by the operation of sprinklers.

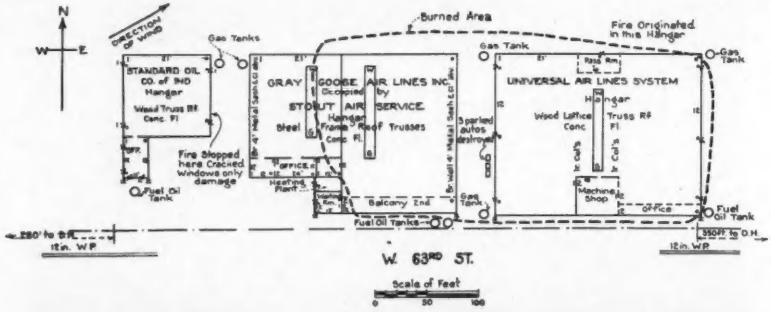
DETROIT, MICH., MARCH 2, 1936. The owner of a plane was repairing a damaged wing and had removed and placed the old fabric on the floor. An



Two more fires at Roosevelt Field. Top, another fire-resistive hangar is completely destroyed. Roof trusses collapsed from the excessive heat. Below, authorities managed to salvage two planes from this hangar.

extension lamp came in contact with this fabric and the heat from the lamp ignited the nitrocellulose coating. The understructure of the wing flared up, but before any of the other planes near by could become ignited, the deluge sprinkler system operated and extinguished the fire. Loss $250.

BOSTON, MASS., JANUARY 14, 1938. Fire in the boiler room of a hangar was caused by backfire of the burner. The fire damaged wiring and parts of



A fire at the Chicago Municipal Airport is told in pictures. Top, the area involved in the fire. Center, the fire at its height. Below, ruins of the hangar following the fire.

the burner, but was extinguished by the operation of one sprinkler on a dry pipe system before any serious loss resulted.

NEW ORLEANS, LA., NOVEMBER 11, 1938. Fire occurred in the hangar after closing hours when a mechanic, anxious to get home, used two 300-watt reflector lamps to dry nitrocellulose dope on airplane wings. Heat from the lamps ignited the dope and fire flashed over the wing of one of the 31 planes in the hangar, representing a total value of $450,000. The fire was just igniting the overlapping surfaces of adjacent planes when the deluge sprinkler system operated, discharging some 2000 gallons per minute through 72 open sprinkler heads in the fire area. The damage was confined to three planes, and was limited to $1700.

NEW YORK, N. Y., MARCH 5, 1940. A loss estimated at $500,000 resulted from a fire which occurred in Hangar No. 4 at the La Guardia Field, North Beach Airport. The fire occurred while automatic sprinkler equipment was being installed in the hangar, which was nearing completion. Sprinkler installation had not been completed when the fire occurred in a painters' shanty inside the hangar and the flames spread to a forest of wooden scaffolding used for the installation of the sprinklers and for painting. The fire was fought unsuccessfully by watchmen using extinguishers and there was some delay in calling the fire department. While sprinklers were not yet in service in Hangar No. 4, 121 open head sprinklers controlled by a deluge valve operated in Hangar No. 6, which was seriously exposed. After numerous fire department pumpers got to work, these sprinklers were shut off, as the residual water pressure was no longer sufficient to supply the sprinklers. One-half of Hangar No. 4 was destroyed.

Typical Fires in Non-Sprinklered Hangars.

The following typical fires occurred in non-sprinklered hangars.

NEAR WILMINGTON, DEL., FEBRUARY 9, 1932. A mechanic was cleaning inside a plane with a wire brush when he noticed the pyroxylin windshield in flames. He used a 1-gallon vaporizing liquid extinguisher, but the flames flashed to the combustible wing fabric. Due to lack of water supplies, the hangar and three planes were destroyed. A volunteer fire department protected an adjacent hangar and office. The loss amounted to $29,923.

CLEVELAND, OHIO, MARCH 3, 1932. A new gasoline pump in the yard ignited while being adjusted for service. A brisk wind carried flames from the burning gasoline pump to the combustible roofing of the hangar. The private fire brigade and public fire department responded promptly and used two hose streams and some foam extinguishers, ending the fire in fifteen minutes. The loss amounted to $600 or more.

MANSFIELD, OHIO, MARCH 18, 1935. An electric light bulb dropped from top of an airplane and broke when it struck the plane, igniting the combustible covering of the fuselage. Two vaporizing liquid extinguishers were used, but the airplane was destroyed. There was no water supply available except the 80-gallon booster tank of water carried on the public fire department truck. The total loss amounted to $12,650, but only minor damage resulted to the building.

MINEOLA, N. Y., DECEMBER 8, 1935. An employee was using an acetylene welding outfit in the repair shop when a spark ignited gasoline which had been spilled on the floor. The blaze at once extended to the frame walls of the building. Employees removed the two or three planes from the hangar and

This hangar at the LaGuardia Field-North Beach Airport in New York City had not been completed when it was swept by fire. Feeding the fire was a forest of non-flameproofed wooden scaffolding, which was being used for the installation of a sprinkler system and for painting. Loss, $500,000.

used chemical extinguishers in an attempt to control the fire. Both private and public fire departments used hose streams to extinguish the fire. The building loss was $9537. The contents loss was not reported.

MINEOLA, N. Y., NOVEMBER 4, 1936. An employee, disregarding airport rules, was cleaning the inside of a plane with gasoline contained in an open pan. The bulb of an extension light was broken when the pan tipped over and the gasoline ignited, setting the plane afire. There were 16 planes in the hangar at the time of fire and employees removed 12 of them. Other employees fought the fire with chemical and carbon dioxide extinguishers. Three planes were destroyed and one was damaged. No damage resulted to the hangar.

MINEOLA, N. Y., JANUARY 12, 1937. Wax being heated over a coal stove in a repair shop section boiled over and ignited. The fire in this lightly constructed frame building was soon beyond control. Employees used chemical extinguishers and a hose stream. The volunteer fire departments which responded to the alarms used two additional hose streams. With the exception of four planes that were removed undamaged, the hangar was practically destroyed, as were the contents. The loss was $17,250.

AMARILLO, TEXAS, NOVEMBER 29, 1937. Fire originated in a plane from an unknown cause. There was no water supply available for fire fighting. The airport had a crash wagon equipped with a 450-gallon tank of water with pump and foam equipment, but no one present knew how to operate the equipment. If this had been put into operation, the fire might have been extinguished with very little loss. A city fire department, eight miles distant, responded to a call for aid. By the time they arrived the fire had gained such headway that it was impossible to save the hangar and planes. The loss amounted to $40,200.

HIALEAH, FLA., APRIL 2, 1938. Ten planes, all with full fuel tanks, were in a hangar at the Miami Municipal Airport when fire occurred. The building was not equipped with an automatic sprinkler system and the only water supply was a well with a capacity of about 600 gallons per minute. Fire apparently started in one of the airplanes. Fuel tanks in the other planes exploded and aided in spreading the fire rapidly to all parts of the building. The watchman was about two hundred feet from the hangar when he discovered the fire. His attempts to use first aid equipment proved futile. The nearest fire department had to travel four miles and another fire department came twelve miles to reach the scene of the fire. When the apparatus arrived the fire had reached such advanced stages that the three weak streams, all that could be supplied from the well, were useless. The loss to building and contents was $360,000.

MINEOLA, N. Y., MARCH 29, 1939. An oil burner explosion ignited sheathed walls of the repair shop section. Employees used chemical extinguishers and thought the blaze had been extinguished. An hour and a half later, it was noticed that flames had spread to the wooden roof supports. A volunteer fire company was called and the fire was extinguished with a hose stream. The loss amounted to $1500.

Magnesium and Its Alloys.

By H. S. Hirst and A. B. Guise,
Chemical Engineers, Factory Mutual Laboratories,
(Members N.F.P.A.).

Magnesium and its alloys are being used increasingly today for the production of light weight metal shapes and parts and for other special parts where the use of magnesium is desired because of some property of the metal other than the lightness. Since magnesium and alloys having high magnesium content will ignite readily when of moderate fineness and cannot be extinguished by usual methods, their increased use has resulted in increased fire hazards in industrial plants using magnesium alloys.

There is also great interest in magnesium used in incendiary bombs. While this article deals primarily with the industrial uses of magnesium, the information on its burning characteristics and extinguishing methods is likewise applicable to incendiary bombs of the magnesium body type.

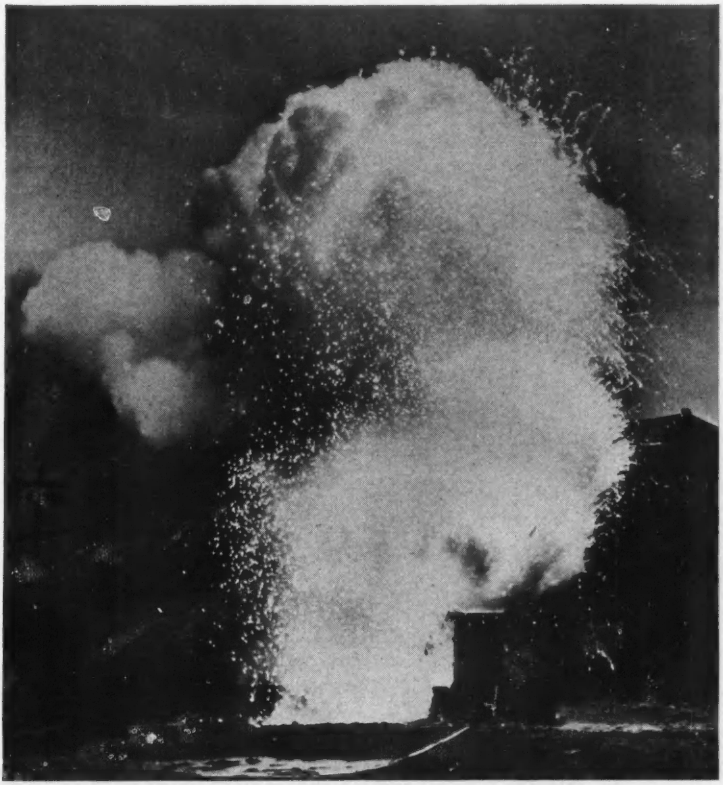
Magnesium is industrially used primarily in the form of alloys with aluminum in which the magnesium content is in the range of 90% to 98%. A common trade name for these alloys is "Dowmetal." The increasing use of magnesium alloys for light weight machine parts, forgings, sheets, and castings and die castings has brought attention to the fire hazard associated with the processing of magnesium alloys and storage of magnesium alloy chips and fine turnings.

Magnesium and alloys containing a large proportion of magnesium are now being worked industrially by many processes, of which those listed below are representative:

1. Sand and permanent mold casting.
2. Die casting.
3. Forging.
4. Extrusion.
5. Production of plate, sheet and strip.
6. Machining.
7. Grinding.
8. Annealing and other forms of heat treating.

Magnesium reacts with water to produce hydrogen and magnesium hydroxide, the water supplying the oxygen necessary for combustion of the magnesium. The reaction is very slight at ordinary temperatures, but increases rapidly as temperatures increase. Water supplies this necessary oxygen much more rapidly than air, hence the extreme violence of the combustion of

NOTE: This article is a revision of the article on the same subject in the October, 1940, QUARTERLY, which has now become obsolete. See Editorial, "Magnesium," on page 296 of this issue.



Heat applied to wet magnesium brought about this violent reaction. At ordinary temperatures, the reaction is only slight. Liberation of hydrogen increases as the temperature is increased.

wet magnesium. The hydrogen produced introduces the additional hazard of a flammable gas.

At normal temperatures magnesium alloys react with water to only a negligible extent, but when the metal is burning the application of water or other common extinguishing agents, such as foam, carbon dioxide, vaporizing liquids (largely carbon tetrachloride), or dry chemical (mostly sodium bicarbonate), will greatly intensify the rate of burning. The application of large quantities of water or vaporizing liquid may result in the burning taking place at an almost explosive rate. Similarly, although the dry or oily metal burns gently and relatively slowly, when scrap such as fine turnings is wet with water and ignited, the wet mass of metal will be consumed with almost explosive rapidity.

A hose stream was directed into this wooden shed where magnesium scrap was burning. Tremendous bursts of flames resulted.

The usual extinguishing agents have no extinguishing effect on burning magnesium alloys, and the best extinguisher for this type of fire is a special powder developed by the Dow Chemical Co. in coöperation with the Pyrene Manufacturing Company, to be marketed by the latter company probably under the name "Magpye Powder." Graphite is next in order of desirability with powdered talc, fine cast iron borings, and fine dry sand having much less suitability as extinguishing agents.

When magnesium burns on a concrete floor the "pops" resulting from a reaction with water of crystallization will scatter burning magnesium over a 10 ft. radius from even a small fire. Magnesium will burn without scattering on a wooden floor. However, a fire on a wooden floor is almost impossible to extinguish by smothering, and water will probably have to be employed to wet down the surrounding area at least. A fire on a concrete floor can readily be smothered.

Magnesium fires, unless fought with a proper understanding of the properties of the material, involve a serious personal hazard to firemen, as is shown by the fire experience reported in this article.

Fire and Explosion Tests.

Numerous fire tests have been made to determine the burning properties of magnesium and its alloys, and to ascertain the most effective extinguishing methods. A number of tests were run with magnesium scrap turnings. The quantities used were the contents of 55-gal. drums. In some of the tests the scrap was ignited as received, wet with the kerosene used as a cutting oil. In these tests the scrap burned slowly. In other tests, the scrap was wet with water and when ignited the wet scrap burned with almost explosive violence.

Several previous tests had been made to illustrate proper and improper methods of extinguishing small fires in burning magnesium alloy chips. Water was used on a fire and resulted in a violent reaction. Vaporizing liquid as an extinguisher intensified the reaction but not with the violence of water, probably because only a small amount of extinguishing liquid was applied. Foam, carbon dioxide and dry chemical extinguishers, while not increasing the combustion of the magnesium alloy greatly, were of no value in extinguishing the fire. Powdered talc, shoveled gently on to the burning material, was of some value on the burning magnesium alloy, but the hot magnesium in some cases burned for a considerable time beneath talc. Later tests with other commercial grades of talc have indicated that talc may contain sufficient quantities of mechanically combined moisture to actually increase the intensity of the burning of the magnesium over which it is placed.

Recent fire tests made to test a new extinguishing powder probably to be called "Magpye Powder," developed jointly by the Dow Chemical Company and the Pyrene Manufacturing Company, indicated that this powder is far superior to other extinguishing agents tested on magnesium fires.

The action of the various common extinguishers shows that only a material inert to magnesium is effective in extinguishing such fires. Small magnesium fires have also been extinguished with lubricating oil, but this method is impractical on larger quantities of metal.

Laboratory tests have been conducted to determine the amount of hydrogen liberated by fine magnesium alloy turnings in contact with water at both normal and elevated temperatures. These tests show that while hydrogen is generated by magnesium alloy chips in contact with water, the rate of evolution is so small as to be practically unimportant from the standpoint of explosion hazard if ample natural draft ventilation is provided. However, if the magnesium alloy is in much more finely divided form such as dust, special arrangements should be made to provide adequate ventilation.

Dust explosion tests on powdered magnesium have been conducted by the Laboratories in the modified Clement-Frazier dust explosion bomb in which pressures as high as 69 lb. per sq. in. were recorded. As a measure of relative explosion hazard, similar tests in this equipment with aluminum powder have given pressures of 37 lb. per sq. in., and with cornstarch, pressures of 32 lb.

The Industrial Storage and Handling of Magnesium and Alloys.

The most important recommendation for industrial storage and handling of magnesium and its alloys is the isolation of magnesium from water. The second is good housekeeping, with frequent removal of chips, fine turnings and other scrap metal, and storage in tightly closed metal containers well away from manufacturing areas, and third, proper protection for the collection and disposal of magnesium dusts. These recommendations are outlined in more detail below for specific processes using magnesium and its alloys.

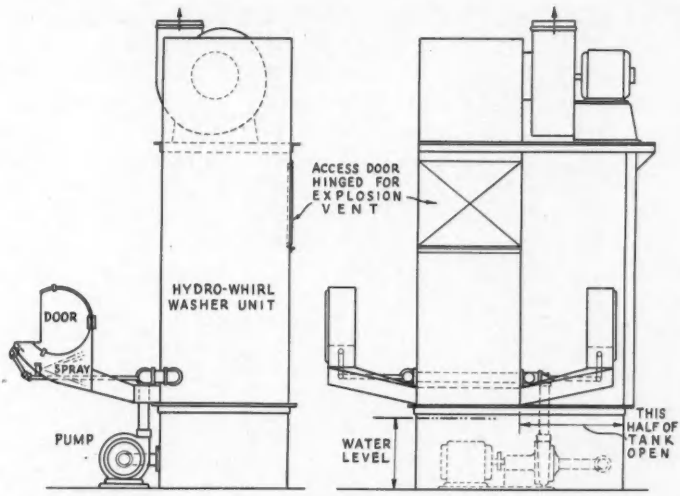
MACHINING OPERATIONS. No water, even in mulsifiable cutting oils, should be used in machining operations. If dry machining is not practical, a mixture of kerosene or mineral seal oil and lard oil, or straight kerosene or mineral seal oil is preferable. The use of lard oil introduces the hazard of spontaneous heating in large accumulations of the magnesium scrap. Other cutting oils have been developed for use with magnesium and have proven practically successful. Tests of a number of these oils have disclosed no spontaneous heating hazard. Arrangements should be made to sweep the turnings away constantly from beneath the tool, so that if ignition of the magnesium alloy does take place at the tool, there will be no metal near by to which the fire can readily spread. The turnings should be frequently placed in a covered metal container and the containers should be emptied at the end of each shift into other tightly covered metal containers which should be removed from the manufacturing areas. It is important that no turnings should be left in these areas overnight. Turnings should preferably be stored in a non-combustible building in tightly covered metal containers separated from other combustible material. Storage in a combustible building protected by automatic sprinklers is acceptable if containers are tight against the entrance of water. A large accumulation of turnings in storage should be avoided and the material should be returned to the recovery plant and melted down into solid ingot as soon as possible.

Automatic sprinklers should not ordinarily be removed from over magnesium machining operations. The fires that occur at the machines are usually small and the sprinkler discharge wets down and protects the surroundings from burning magnesium thrown for short distances by the minor "pops" which may take place.

Most fires occurring during machining operations are caused by friction between the tool and the work. This is particularly liable to happen when taking fine finishing cuts at high speed if the tool is dull.

Experience will show the skilled machinist the necessity of keeping the tool sharp on finishing operations.

GRINDING OPERATIONS. Ordinary type dust collectors should not be used for removing magnesium dust. A special dust collecting system should be used which utilizes a water spray nozzle to knock down the dust so that it may be



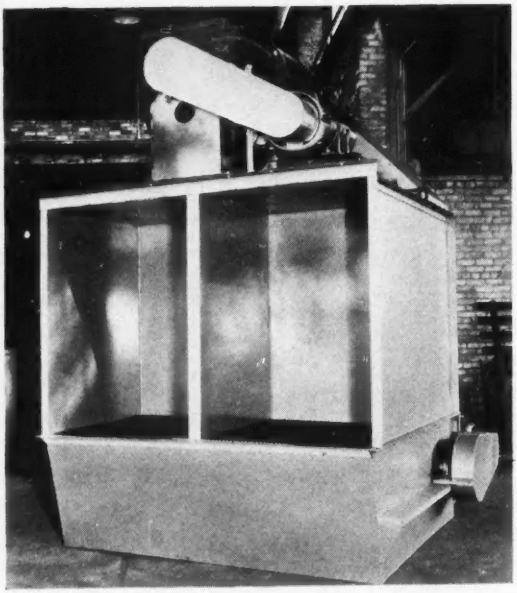
Industrial Sheet Metal Works.

Water wash collector for external grinding wheels for magnesium alloy parts.

carried away as a sludge. This is one rare exception to the normal isolation of magnesium from water. Good ventilation should be provided to remove the hydrogen which is formed. The sludge should be collected in drums and frequently disposed of by mixing with about 4 or 5 parts by weight of sand or dirt and burying in a dump. The sludge should not be allowed to stand in the half-wet condition, as a reaction between the magnesium and water might cause the temperature to rise to a point where ignition could occur. The amount of magnesium alloy involved and the hazard connected with the grinding process do not warrant attempts to reclaim magnesium dust.

Grinding wheels for use with magnesium and its alloys should not be used for other metals and frequent cleaning around the grinding operation is essential to prevent accumulations of dust. The fire hazard involved in the temporary storage pending disposal of dry grinding dust, floor sweepings, and sawdust may be considerably decreased by wetting this refuse material with a cheap high flash point mineral oil. This material can then be safely disposed of by either burning on a dump or mixing with sand and burying as mentioned above.

Booths and collectors of special design for the grinding of magnesium alloys are now commercially available from the Industrial Sheet Metal Works, Detroit, Michigan. Other similar equipment of good design may be available but is not known to the authors.



Industrial Sheet Metal Works.

Booth for flexible shaft filing, grinding and polishing of magnesium alloy parts.

FOUNDRIES AND DIE-CASTING. Foundries and die-casting operations using molten magnesium or its alloys should be located in non-combustible fire-resistive buildings where sprinkler protection is unnecessary since automatic sprinklers may actually increase the fire hazard. Foundries should be on the first floor of such buildings and ceilings should be high, so that burning vapors of magnesium will neither damage the ceiling nor "mushroom" and spread the fire. The floor around the melting units and where there is danger of spilling molten metal should be of hard-burned or vitreous paving block.

The furnace settings must be cleaned often enough to keep them free from iron scale. If molten magnesium runs on to hot scale, a thermit reaction may occur, forming iron and magnesium oxide, probably with explosive violence.

A flux is used on the surface of the molten metal in melting pots and a mixture of sulphur and boric acid is used to prevent ignition in ladling and can be used to extinguish small fires from splattering of the molten metal in pouring into molds.

ANNEALING AND OTHER HEAT-TREATING PROCESSES. Careful design and control of heat-treating furnaces are necessary to prevent overheating the

magnesium alloy by radiation from electric heating elements or brickwork at a temperature higher than the atmosphere within the furnace. Massive pieces will not ignite readily, but thin projections or fine material in a casting constitute a definite hazard, since the burning of these smaller pieces is communicated to the body of the casting.

Maintenance of an atmosphere of 1% sulphur dioxide in the heat-treating furnace partially prevents ignition of magnesium alloy parts, probably by the formation of a magnesium sulphide film over the surface of the pieces. Sulphur dioxide will not serve as a completely effective fire extinguisher, however, since burning castings will continue to burn although burning molten magnesium will be extinguished.

Tests made with sulphur dioxide atmospheres on burning magnesium alloy turnings showed that burning increases over the rate in still air. However, the industrial fire experience indicates that 25% of the charge to a furnace may be recovered as melted scrap from the floor of a furnace which has been flooded with sulphur dioxide when the charge ignited.

The heat treating temperatures ordinarily are from 730° F. to 780° F., and at temperatures below the latter figure magnesium alloy castings may be held for long periods without ignition. Ignition has been reported when furnace temperatures have been in excess of 800° F.

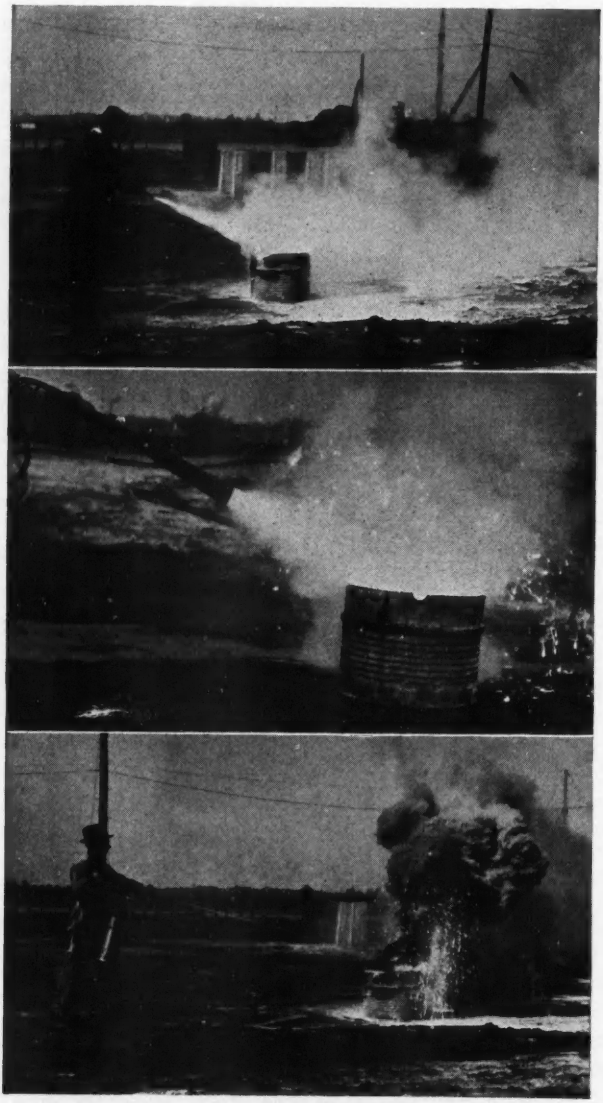
STORAGE. Although finely divided magnesium alloy will ignite readily, larger pieces such as castings and billets do not ignite except when heated to about 900° F. for a considerable period of time. Accordingly, although storage of such material should be in a noncombustible building away from other more readily combustible material, storage in an ordinary sprinklered building is reasonably safe because of the probability that any fire in other contents or involving the building construction will be extinguished before there is sufficient heat to ignite the magnesium.

Extinguishers.

The best commercially available extinguishing agent for fires in magnesium alloys is "Magpye Powder," offered by the Pyrene Manufacturing Co. The next best is powdered graphite. Talc, fine cast iron borings, and sand follow in decreasing order of effectiveness. Talc and sand vary in effectiveness, according to the moisture and chemically combined water content. Cast iron borings, unless wet with oil, will rust into a hard unusable mass.

The "Magpye Powder" is composed of a non-flammable powder inert to magnesium, with which is incorporated a small percentage of nearly non-flammable material which forms a heavy vapor when heated and excludes air.

Sand should not be used around machining operations, since complete overhauling of machinery is necessary after the fire to prevent damage by the abrasive particles of the sand.



Various types of fire extinguishers being used on burning magnesium. In each case, use of the extinguisher only serves to accelerate the burning. Top: Dry chemical. Center: Carbon dioxide. Bottom: Vaporizing Liquid.

Burning magnesium can sometimes be extinguished by covering it with powdered talc.

Wheeled bins containing scoops and one of the above extinguishing agents (except sand) should be located at strategic points around machining operations for use in extinguishing magnesium fires.

Where fire in magnesium alloys has attained considerable size upon arrival of the fire department, in most cases the least hazardous course to follow is to prevent extension of the fire to exposed buildings by the liberal use of hose streams, without allowing any water to come in contact with the burning magnesium. The use of water on buildings where magnesium is stored is dangerous under any conditions, and should only be attempted if it is certain that water will not reach the burning magnesium itself.

A number of so-called "extinguishers" have been tested using materials inert to magnesium, but which in themselves are flammable. These have not been used on fires involving more than a pailful of scrap turnings. Lubricating oil or mixtures of carbon tetrachloride and lubricating oil are representative of this class and have not proven satisfactory, since it is difficult to apply the mixture to the burning magnesium alloy without causing the oil itself to ignite.

Fire and Explosion Record.

With the increasing use of magnesium alloys, fires and explosions are being reported with increasing frequency. The following summaries include the more important fires and explosions reported, and several which involved only a small loss, but which are of interest as illustrating the importance of proper fire fighting procedure. Several other fires and explosions involving

only small losses and similar to those summarized, have not been included in this record.

BLOOMFIELD, N. J., JAN. 25, 1928. Magnesium alloy castings were being turned on a lathe when the cutting tool struck sparks from sand imbedded in the metal. Turnings ignited and opened one sprinkler. The fire burned itself out, with a loss of about $350.

BLOOMFIELD, N. J., JAN. 26, 1934. A cutting tool struck sparks from sand imbedded in a magnesium alloy casting and magnesium turnings ignited. When almost extinguished by talc, a sprinkler operated, washed off the talc and intensified the fire. Water and fire badly damaged the machine. The loss was approximately $500.

CLEVELAND, OHIO, SEPT. 17, 1935. Molten magnesium alloy was about to be poured from a ladle into molds, when the tipping mechanism became deranged and the molten metal flowed onto a concrete floor which probably contained considerable moisture, since the magnesium alloy ignited at once and was finally extinguished with sand only after most of the metal was consumed. The loss was approximately $110. A factor in the low loss was a high, non-combustible roof in the foundry building which was not damaged by the heat from the burning magnesium.

PITTSBURGH, PENNA., DEC. 16, 1937. Magnesium alloy billets ¼ in. and 1 in. in thickness were being heated to 990° F. prior to rolling. Ignition of the billets occurred, causing damage of $400 to the furnace.

PITTSBURGH, PENNA., FEB. 1, 1939. A small fire occurred during the sawing of a magnesium bar. The saw and motor had to be dismantled to remove sand used in extinguishing the fire.

EAST RUTHERFORD, N. J., FEB. 9, 1939. A cutting tool came in contact with a steel wedge used to secure a magnesium alloy casting in a milling machine. The sparks ignited the chips on the bedplate. Although sand was used in an attempt to extinguish the fire, a sprinkler head opened and intensified the fire in the considerable quantity of chips. The loss of $600 was largely due to the labor cost of removal of sand from the milling machine.

BATAVIA, N. Y., FEB. 15, 1939. In a plant engaged in die-casting of magnesium alloy, scrap was being reclaimed in a large gas-heated pot located in a small corrugated iron on steel frame building. Some of the scrap was wet and the pot was being heated slowly to drive off moisture. The heat caused a rapid reaction between the magnesium and water and an "explosion" resulted which burned two men fatally. The public fire department responded and extinguished the fire by shoveling cast iron chips on to the burning magnesium alloy, although most of the charge had been consumed before they arrived. The property loss was about $300.

PITTSBURGH, PENNA., DEC. 20, 1939. Magnesium sawdust was ignited by sparks from a welding torch. The fire was extinguished by the use of talc with a loss of only $65.

HARTFORD, CONN., JAN. 31, 1940. Twenty-five hundred pounds of magnesium alloy turnings in wooden barrels and boxes with burlap covers, together with large amounts of aluminum and brass turnings, were stored in wooden sheds. One shed became ignited and the fire spread to the magnesium. The public fire department was called and although they were cautioned about the use of water on magnesium, several large hose streams were applied to the

buildings involved in the fire. Water coming in contact with the magnesium resulted in an explosion of the rapidly burning material, causing a shower of burning magnesium and an increase in the intensity of the fire, which ultimately resulted in the destruction of four wooden buildings. The loss was approximately $7000.

HOUNSLOW, ENGLAND, FEB. 14, 1940. A fire started in a storage shed containing 15 tons of magnesium scrap and spread to several other wooden sheds and a brick building containing over 200 tons of aluminum scrap. This fire occurred in a small town in England and burned for over 48 hours, because the fire was spread by explosive reactions caused by playing more than 20 hose streams on the burning magnesium and aluminum. Two near-by dwellings were destroyed by the explosions. Apparently the danger of using water on magnesium fires was not realized by the local fire brigade. Fourteen members of the brigade were injured.

YONKERS, N. Y., JUNE 12, 1940. A magnesium alloy pulley was being turned on a lathe when turnings became ignited by friction. Vaporizing liquid extinguishers which were used only intensified the fire, which finally burned itself out. The loss was $30.

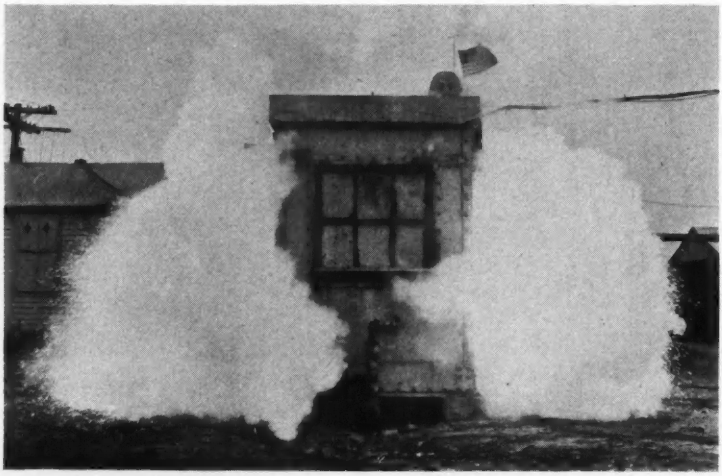
PATERSON, N. J., SEPT. 9, 1940. Fifteen hundred pounds of magnesium alloy turnings in a scrap metal yard were stored in burlap bags in wooden bins in a one-story cement block building with joisted floors and roof. The dealer had not previously handled this type of scrap and was probably unfamiliar with its fire hazard. The fire department used a hose stream without knowing the fire was in magnesium alloy and several firemen were badly burned by the resulting flash. Thereafter the hose streams were directed only on other combustible material, although an unsuccessful attempt was made to extinguish the fire by the use of a spray nozzle. A load of sand was obtained, but it was damp and the scrap continued to burn beneath the layer of sand. The loss was about $300.

Magnesium Fires in Heat-Treating Furnaces.

LITTLE FALLS, N. J., JUNE, 1939. Magnesium alloy castings in an electrically heated circulating atmosphere heat-treating furnace ignited. Since no one knew how to handle the fire, nothing was done for a while, then the public fire department is said to have been called. It is understood that the furnace doors were opened and a hose stream thrown on the burning castings within the oven. Details are lacking from this point on, but the loss is understood to have been $50,000, although this appears rather high.

CLEVELAND, OHIO, JULY 28, 1940. A large electrically heated furnace with a recirculating fan was being used for the heat treatment of 5300 lbs. of castings of 88% magnesium alloy. The temperature was said to be 800° F. and iron pyrites were placed in the furnace to form a sulphur dioxide atmosphere. The castings ignited after being in the furnace for 21 hours and were completely consumed, even though sand was piled around all openings. The heat melted some of the fire brick and the arch and one wall collapsed. The property loss was about $18,000.

ADRIAN, MICH., JAN., 1941. Two thousand pounds of magnesium alloy castings in an electrically heated circulating atmosphere furnace ignited. The furnace was flooded with sulphur dioxide, extinguishing the fire in the molten magnesium alloy on the floor of furnace, but not extinguishing the burning



Magnesium dust explosions are violent. Shown here is an explosion caused by only two and a half pounds of the material. Left: One and a quarter pounds of powdered magnesium being poured into each of two large open cups. These cups were then attached to the ceiling of the small but strongly constructed house (above). The powdered metal was scattered throughout the house by compressed air and ignited by a gas flame. Bursts of smoke from the resulting explosion are being emitted from standard explosion venting windows. Window in the foreground was secured.

castings. Fire hundred pounds of magnesium alloy scrap was recovered, but the castings were consumed or melted. The damage to the furnace and the total loss are unknown.

CLEVELAND, OHIO, MARCH 30, 1941. A charge of 1000 lb. of magnesium alloy castings was being treated in an unsupervised direct-gas-fired core oven, being used because other heat treating equipment was inadequate to take care of production. The thermostat failed and the resulting overheating of the oven ignited the castings. The oven, the small unsprinklered corrugated iron building in which it was housed, and wooden flasks stored in the building were destroyed. The loss was about $3000.

Magnesium Dust Explosions.

NEW YORK, N. Y., JULY 18, 1922. Magnesium powder was stored in part metal and part waterproof paper-lined cases in a general warehouse. The cases were being removed when ignition of the powder was caused by friction or a spark from a handling hook. Several minor explosions occurred and when a hose stream was applied it had no effect on the fire. It appears that this may not have been a true dust explosion, but an explosion of flashlight powder. One man was killed and 20 injured in fighting this fire. The property loss was $1,000,000.

NIAGARA FALLS, N. Y., FEB. 16, 1926. Magnesium dust was being screened after manufacture in a ball mill. Ignition from an unknown source caused an explosion which damaged the equipment and the building. The loss was approximately $3500.

CLEVELAND, OHIO, FEB. 20, 1930. Dust from the grinding of magnesium alloy castings was wet by spray only after it had passed through about 40 ft. of duct instead of having the water spray close to the grinding wheel. A casting had been made, using a wire nail to hold the core upright. When the riser was ground off, sparks from the wire nail ignited the dust and caused an explosion which ruptured the ducts, air washer, and fan housing, and broke about 200 lights of glass. The loss was $800.

CLEVELAND, OHIO, DECEMBER 20, 1940. During the weekly inspection of equipment in a magnesium powder plant, a mechanic moved a reciprocating feed mechanism by hand while trying to locate the source of a squeak. The travel of the mechanism probably exceeded normal, causing the moving part to strike a stationary section and produce a mechanical spark. Two men were badly burned by the resulting explosion, but property damage was relatively small since the force of the explosion was vented by explosion-venting panels and windows. The property loss was about $600.

Acknowledgment.

The General Electric Company, Lynn, Mass., coöperated with the Factory Mutual Laboratories by supplying material for fire tests and by supplying information on machining experience with magnesium alloys. The Dow Chemical Co., Midland, Michigan, assisted by contributing their experience with magnesium alloys with respect to fire hazard, extinguishing agents and foundry practice.

Thirteen men died and 26 were injured when this lodging house for destitute male transients in Dallas, Texas, was swept by fire. The blaze began in a cabinet used for disinfecting the men's clothing by heat, located at the top of the single stairway leading to the flimsy wooden partitioned dormitory. On the left, the smoke-stained brickwork above the windows from which the men cried for help. They were reluctant to jump since they were without clothes. On the right, the débris strewn dormitory following the tragedy.

Fires in Which There Was Loss of Life.

First Quarter, 1941.

Reports on 130 fatal fires have been received by the Fire Record Department of the N.F.P.A. during the first quarter of the year 1941, and a total of 292 persons have died as a result of these fires. During this period, the following fires were reported, each of which resulted in the death of five or more persons.

Nov. 28, 1940, Toppenish, Wash. Eight persons were killed when an explosion followed by fire totally destroyed a large warehouse in which several shops were located. The blast resulted from leaking gas.

December 24, 1940, Cornwall, P. Q. An elderly man, a mother and her four children were suffocated by smoke, then burned to death as fire swept through their small frame home. An overheated stove was held responsible for the tragedy. (L-6350.)

December 25, 1940, Oxon Hill, Md. A mother and her five children perished early on Christmas morning in their newly built home near here. Failure of one of the members of the family to turn off all oil stoves in the home before retiring resulted in the six deaths. (L-6351.)

December 28, 1940, Dowells, Md. An overheated chimney, which spread fire and destruction through a dwelling in this town, brought death to six children and their grandfather. Two other members of the family suffered severe burns. (L-6352.)

December 30, 1940, Easton, Me. Four sisters and a housekeeper were burned to death when fire cut off the only stairway exit leading from their home, which was above a general store. Other members of the family succeeded in escaping. (L-6353.)

January 10, 1941, Antioch, W. Va. Instead of attending funeral services for their mother, who had died the previous day, four children and their father ironically became the victims of a fire which reduced their home to ashes. Since the home was in an isolated section, the fire was not discovered until hours after the tragedy occurred. (L-6354.)

January 14, 1941, Brooklyn, N. Y. Heating paint over a kerosene burner was responsible for a rapidly spreading fire in a box factory which claimed the lives of seven men. Many others were injured in escaping from the plant, of which nothing remained but a smoking shell. See Frontispiece. (H-43936.)

February 5, 1941, New Haven, Conn. Ten employees of a plant manufacturing cotton quilts and pads died in a fire which gutted the room in which they were working. See page 357. (H-43937.)

February 7, 1941, Dallas, Texas. Fire which broke out in a cabinet used for "sanitizing" the clothing of destitute male transients claimed thirteen lives. Twenty-six others were so gravely injured that they required hospital treatment. The cabinet in which the fire occurred had been in operation for four years and was considered substantially constructed with proper venting. The reason for the large death toll was said to be fear on the part of the men to run into the street in the nude. (H-43938.)

Loss of Life by Fire, January-March, 1941.*

This is a typical rather than a complete record, presented to show the conditions under which loss of life occurs, that they may be known and guarded against. The total loss of life by fire in the United States is estimated at 10,000 annually.

Occupancy	No. Fires	Men	Women	Children	Total
Apartments, Hotels, Lodgings, Tenements, etc.	25	29	18	12	59
Boats and Ships (except Tank Vessels)	2	1	0	1	2
Dwellings—rural	37	23	18	49	90
Dwellings—urban	33	17	13	26	56
Dwellings—trailers	2	1	1	0	2
Forest and Brush Fires	2	1	1	0	2
Garages and Filling Stations	3	2	0	1	3
Gas Works	1	7	0	0	7
Hospitals and Institutions	1	0	0	1	1
Manufacturing Occupancies	8	23	2	0	25
Mercantile Occupancies	1	1	0	0	1
Military Property	2	3	0	0	3
Mining Property	1	4	0	0	4
Motor Vehicles (except Tank Trucks)	3	6	2	0	8
Tank Trucks	2	2	1	0	3
Out-of-Door Fires	1	1	0	0	1
Railroad Rolling Stock	1	1	0	0	1
Response to Alarms	1	1	0	0	1
Schools and Colleges	1	1	0	0	1
Theatres	1	13	0	0	13
Other Occupancies	2	8	1	0	9
Total	130	145	57	90	292

*This table is made up from those reports received by the Department of Fire Record between December 26, 1940, and March 15, 1941. A few of the fires included herein occurred prior to December 26, but were not reported until subsequent to that date.

FEBRUARY 11, 1941, PHILADELPHIA, PA. In three explosions, which totally destroyed four buildings and partially destroyed eleven others, five persons were burned beyond recognition. The explosions resulted from the leakage of illuminating gas. A score of other persons were badly injured. (H-43939.)

FEBRUARY 15, 1941, DUQUOIN, ILL. A plant blast so terrific that débris was strewn over one-quarter of a square mile of area killed seven men, throwing one of the bodies 250 feet. The plant was used for manufacturing liquid oxygen explosives for use in coal mining. (H-43940.)

FEBRUARY 22, 1941, CAVE JUNCTION, OREGON. Fire spreading from a kitchen stove and involving a ranch house here, claimed the lives of four children and their young mother. (L-6355.)

MARCH 10, 1941, BROCKTON, MASS. Thirteen firemen, one-tenth of Brockton's fire department, were killed when the roof of a theatre in which they were fighting a fire, collapsed because of structural weaknesses. See page 348.

Foreign Fires.

FEBRUARY 17, 1941, SANTANDER, SPAIN. A conflagration, which swept through this city of 30,000 population, left scores homeless and an undetermined number dead. The cause of the fire was a disastrous hurricane which swept Portugal and the eastern coast of Spain. The property loss was estimated at anywhere from $9,000,000 to $13,000,000. Firemen and fire apparatus came to the stricken city from as far away as Madrid, over miles of snow covered mountain roads. (H-43942.)

Causes of Loss of Life, January-March, 1941.

Fatalities classified according to the immediate cause of the loss of life rather than according to the cause of the fire.

Cause of Fatality	Men	Women	Children	Total
Asphyxiation (Smoke and Gas Suffocation)	8	9	9	26
Children Alone in House	0	0	9	9
Clothing Ignited				
1. Candles and Torches	0	1	1	2
2. Electrical Appliances	1	0	0	1
3. Furnaces, Stoves, and Heaters	1	4	2	7
4. Smoking and Matches	3	0	0	3
5. Smoking in Bed	3	0	0	3
6. Miscellaneous	1	2	1	4
Entering a Burning Building	1	0	0	1
Escaping Fire: Jumped, Fell or Drowned	0	1	0	1
Explosions				
1. Chemicals	3	0	0	3
2. Explosives	1	0	0	1
3. Manufactured and Natural Gases	16	3	1	20
4. Miscellaneous and Unknown	1	0	0	1
Fire Fighting—Firemen	19	0	0	19
Fire Fighting—Civilians	3	0	0	3
Flammable Liquids and Vapors				
1. Gasoline and Similar Liquids				
(a) Stoves, Lamps, and Torches	0	0	2	2
(b) Used for Cleaning Purposes	1	2	0	3
2. Kerosene, Range Oil, and Fuel Oil				
(a) Used to Kindle Fire	3	3	2	8
3. Paint, Varnish, Removers, Thinners, etc.	6	0	0	6
4. Miscellaneous and Unknown	0	2	0	2
Indirect Causes (overexertion, exposure, etc.)	1	2	0	3
Marine Fires	1	0	1	2
Mine Fires and Explosions	4	0	0	4
Motor Vehicle Fires (except Tank Trucks)	6	2	0	8
Tank Trucks	2	1	0	3
Railroad Rolling Stock Fires	1	0	0	1
Response to Alarms	1	0	0	1
Trapped in Burning Buildings	58	25	61	144
Miscellaneous Known Causes	0	0	1	1
Total	145	57	90	292

Typical Loss of Life Fires.

Asphyxiation.

JANUARY 18, 1941, KINGSTON, ONT. Four persons, including the entire family of a lieutenant in the Canadian Army who is overseas, were suffocated when smoke from a basement fire billowed into their third-story apartment. (H-43943.)

FEBRUARY 26, 1941, HAVERHILL, MASS. Fire of incendiary origin swept through an apartment and a tenement located next to each other in this city. A man and his wife were asphyxiated and burned to death in the apartment; another woman died under similar circumstances in the tenement. More than 150 persons made their escape safely. (H-43944.)

Children Alone in the House.

JANUARY 12, 1941, SHINING TREE, ONT. An overheated stove in a dwelling was responsible for the death of three small children who were left alone while their father attended to his traplines and their mother visited a friend.

An illuminating gas leakage was responsible for this Philadelphia explosion which took the lives of four and injured a score of other persons. Four buildings were totally destroyed in the series of three explosions.

Attempts by neighbors to extinguish the fire and to save the children were unsuccessful. (L-6356.)

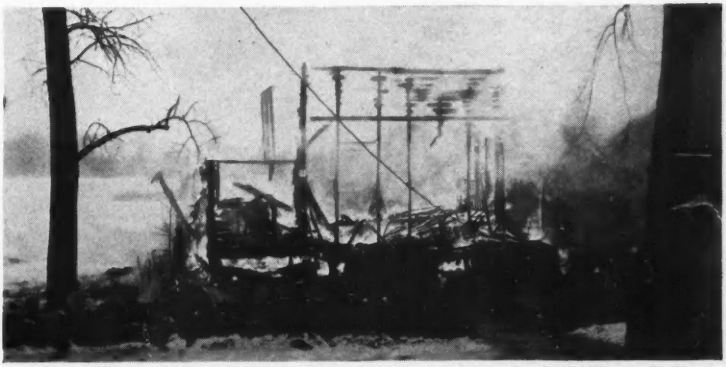
JANUARY 15, 1941, LEICESTER, MASS. Fire of undetermined origin broke out in a dwelling and claimed the lives of four small children whose parents were drawing water from a well 100 yards from the house. It is believed that the children may have upset a wood burning stove in the kitchen. (L-6357.)

Clothing Ignited.

DECEMBER 25, 1940, CLIFFSIDE PARK, N. J. A two-year-old boy, who left his Christmas toys to wander in the basement of his house, opened the furnace door and was caught in a back-draft which ignited his clothing. Attempts of a relative to extinguish the burning clothing were unsuccessful and the boy died five hours later from burns received. (L-6358.)

JANUARY 8, 1941, MONTREAL, P. Q. A short circuit in an electric heating pad was responsible for the death of an 83-year-old man here. The short circuit ignited the bedclothes while he was sleeping and he was evidently unable to escape. (L-6359.)

FEBRUARY 10, 1941, SOMERVILLE, MASS. A two-year-old girl died in the hospital here from burns suffered when her nightgown was set afire in the kitchen of her home. (L-6360.)



Two children were burned to death in this dwelling fire in LaPorte, Indiana. Away at the time were the children's parents, who had locked their children in. Three other near-by cottages were also destroyed.

FEBRUARY 14, 1941, MAISONNEUVE, P. Q. One man was burned to death when a short circuit in a high power electric cable set fire to his clothes. Another man was badly burned when he tried to rescue his friend. (L-6361.)

Flammable Liquids and Gases.

DECEMBER 25, 1940, BARBOURSVILLE, VA. In an attempt to clean their stove for the Christmas holidays, two aged sisters were fatally burned when the polish "exploded." (L-6365.)

DECEMBER 31, 1940, WICHITA FALLS, TEXAS. A home-made gasoline torch "exploded" in the small tire and battery shop and fatally burned a two-year-old child. Seven others were severely injured. (L-6366.)

JANUARY 7, 1941, NORRIS CITY, ILL. The use of kerosene to kindle a fire brought death to a mother and three of her daughters. (L-6368.)

JANUARY 12, 1941, NORTH PROVIDENCE, R. I. Fire claimed the life of a 76-year-old man here when an oil stove in which he was cooking his breakfast overturned and set fire to the room. (L-6369.)

Trapped in Burning Building.

DECEMBER 26, 1940, HALIFAX, N. S. A seaman was burned to death and seven others were injured in a fire that leveled to the ground a three-story wooden navy barracks building. (H-43946.)

DECEMBER 26, 1940, MARSHFIELD, MASS. An incendiary fire which destroyed a three-story inn also claimed the life of one of the co-owners who was the arsonist. (H-43947.)

JANUARY 16, 1941, NEW YORK CITY. A century old three-story brick building in the Chinatown district of this city was gutted by fire which claimed the lives of three Chinese. (H-43948.)

JANUARY 17, 1941, SPOKANE, WASH. Fire which originated in a clothing store adjoining a hotel here, spread to the top floor of the hotel, mushroomed, and trapped two men and a woman. All three burned to death. (H-43949.)

VOLUME XXXIV. INDEX.

A	Quarterly No.	Page No.
Abbreviations of British Fire Terms	4	327
Aberdeen (Wash.) Plywood Company Fire, *Washington Surveying and Rating Bureau*	1	47
Airplane Hangar Fire Record	4	363
Alloys, Magnesium	2	125
	4	374
Apartments, Fire Record of	3	232
Apartment Fire, Yonkers, N. Y.	3	219
Argentina, Llao Llao Hotel Fire. *G. W. Gill and O. A. Gray*	1	64
Armory Fire, Atlanta, Ga	3	230
Arson in Times of War. *Dr. Richard C. Steinmetz*	1	34

B		
Baltimore, Md., Cork Yard Fire	2	136
Blackout, Out of the. *John A. West, Jr.*	4	302
Board of Directors, Meetings of:		
May 8, 1940	1	8
June 24, 1940	1	9
January 18, 1941	4	298
Boats, Fire Record of	1	79
Bombs:		
Explosive	4	314
Handling Explosive and Incendiary	3	208
Sabotage by	3	215
Total Fire, the Incendiary	2	102
Braintree, Mass., Gas Plant Explosion	1	61
Bridge Fire, Kansas City, Kansas. *Kansas Inspection Bureau*	1	76
British Fire Officer, Personal Experiences of	4	315
British Fire Problems	4	302
British Fire Terms, Abbreviations	4	327
British Fire Terms, Glossary	4	327
British Firemen	4	330
Brockton (Mass.) Theatre Tragedy. *Warren Y. Kimball*	4	348
Butadiene, Hazards of	1	7

C		
Camden, New Jersey, Conflagration	2	157
Chicago Fire Prevention Exhibit	4	331
Cities, 1940 Fire Record of	4	332
Cities, Canadian, 1940 Fire Record of	4	343
City Fire Loss Results. *Editorial*	2	100
Colon, Panama, Conflagration. *Com. L. J. A. Ducruet*	1	55
Conflagrations:		
Camden, N. J.	2	157
Colon, Panama	1	55
Cork Yard Fire, Baltimore, Md.	2	136
Cotton Picker Fire, New Haven Quilt and Pad Co. *Robert S. Moulton*	4	357
Cotton Warehouse Fires:		
Blytheville, Ark.	3	229
Hearne, Texas	3	229

D		
Dance Hall Holocaust, Natchez, Miss. *Mississippi State Rating Bureau*	1	70
Defense Fire Protection. *Editorial*	3	191
Defense Industry Fires and Explosions. *Editorial*	2	100
Defense Plan, The Maryland, Fire. *J. W. Just and John F. McNulty*	3	193
Defense Plant Fire, Brooklyn, N. Y.	4	292
Drying by Infra-Red Lamps. *Benjamin Richards*	1	26

E		
Electron Bomb, The	2	104
Exhibit, Chicago Fire Prevention	4	331
Explosions:		
Cincinnati, Ohio	3	285
Gas Plant, Braintree, Mass.	1	61
Hercules Powder Co., Kenvil, N. J.	2	174
Philadelphia, Penna.	4	390
Terre Haute, Ind.	3	228
Explosive Bombs:		
Handling	3	208
Sabotage by	3	214
Sprinkler Protection Against	4	314
	4	374
Extinguishers:		
For Magnesium Fires	4	374
For Incendiary Bombs	2	108

F		
Farm Machinery Plant Fire, Hopkins, Minn.	3	223
Fire Bird Ballet, The. *Editorial*	2	101
Fire Defense. *Editorial*	2	99
Fire Defense. *Editorial*	4	295
Fire Defense Plan, The Maryland. *J. W. Just and John F. McNulty*	3	193

	Quarterly No.	Page No.
Fire Losses:		
U. S. 1939	1	59
Canadian 1939	1	60
Classified 1939	2	149
U. S. 1940	3	217
Large Loss Fires	3	218
U. S. Cities, 1940	4	332
Canadian Cities, 1940	4	343
Fire Prevention Exhibit, Chicago	4	331
Fire Records:		
Airplane Hangars	4	363
Apartments	3	232
Hotels	3	232
Lodging Houses	3	257
Motor Craft	1	79
Rooming Houses	3	257
Seasonal Hotels	3	256
Tenements	3	237
Fire and War. *Editorial*	1	5
Firemen, British	4	330
Fireworks Law Campaign. *Editorial*	4	294
Foreign Fires:		
Santander, Spain	4	390
Sogamoso, Colombia	3	286
Fuses, Type "S"	4	344

G

Gas Plant Explosion, Braintree, Mass.	1	61
Glossary of British Fire Terms	4	327
Government Control of Fire Defense (British)	4	311
Group Fire, Columbus, Miss.	3	219

H

Handling Explosive and Incendiary Bombs. *W. J. Scott*	3	208
Hangar, Airplane, Fire Record of	4	363
Hangar Fire, New York, N. Y.	3	221
Hazards, New. *Editorial*	1	6
Holocausts:		
Dance Hall	1	70
Rail Car	2	142
Hospital Fire, Cincinnati, Ohio	2	184
Hotel Fires:		
Billings, Mont.	3	226
Llao Llao, Argentina	1	64
Record of	3	232
Record of Seasonal	3	256

I

Incendiary Bombing of Oil Tanks	1	13
	2	119
Incendiary Bomb, The—Total Fire. *John A. West, Jr.*	2	102
Incendiary Bombs:		
Handling	3	208
Sabotage by	3	214
Sprinkler Protection Against	4	313
Infernal Machines	3	215
Infra-Red Lamps, Drying by. *Benjamin Richards*	1	26

K

Kansas City, Kansas, Bridge Fire. *Kansas Inspection Bureau*	1	76
Kenvil, N. J., Hercules Powder Company Explosion	2	174

L

Large Loss Fires, 1940	3	218
Llao Llao Hotel Fire, Argentina. *G. W. Gill and O. A. Gray*	1	64
Lodging Houses, Fire Record of	3	257
Lodging House Fire, Dallas, Texas	4	389
London Fire Brigade	4	302
Reorganization for Defense	4	305
Loss of Life Fires:		
Second Quarter, 1940	1	90
Third Quarter, 1940	2	184
Fourth Quarter, 1940	3	285
First Quarter, 1941	4	389
Lumber Plant Fire, Dallas, Ore.	3	228

M

Magnesium. *Editorial*	4	296
Magnesium and Its Alloys. *H. S. Hirst and A. B. Guise*	2	125
	4	374
Marine Fire Fighting in New York. *Albert B. Carlson*	1	14
Maryland Fire Defense Plan, The. *J. W. Just and John F. McNulty*	3	193
Mercantile Building Fire, Redding, Calif.	3	218
Mine explosions:		
Bates, Ark.	2	185
Beckley, W. Va.	3	285
Cadiz, Ohio	3	285
Sonman, Pa.	2	185
Motor Craft, Fire Record of	1	79
Multiple Occupancy Fires:		
St. Joseph, Mo.	3	226
St. Louis, Mo.	3	219

N

Natchez, Miss., Dance Hall Holocaust. *Mississippi State Rating Bureau*	1	70
N.B.F.U. 75 Years. *Editorial*	4	297
New Haven Quilt and Pad Co. Fire. *Robert S. Moulton*	4	357

	Quarterly No.	Page No.
New Hazards. *Editorial*	1	6
New Orleans (La.) Warehouse Fire. *H. P. Dixey and W. J. Moll*	4	352
New York and London Fire Departments	4	302
New York, Marine Fire Fighting in. *Albert B. Carlson*	1	14
New Zealand Newsprint Paper Fire	1	69
Northwestern University Fire, Evanston, Ill.	3	230

O

Oil Tank Fire, Texas City, Texas	3	231
Oil Tanks, Incendiary Bombing of	1	13
	2	119
Out of the Blackout. *John A. West, Jr.*	4	302

P

Packing Plant Fires:		
Brantford, Ont.	3	226
Martinsville, Ind.	3	228
So. Edmonton, Alta.	3	223
Paper Fire, New Zealand Newsprint	1	69
Personal Experiences of a Professional Fire Officer	4	315
Plywood Company Fire, Aberdeen, Washington. *Washington Surveying and Rating Bureau*	1	47
Powder Company Explosion, Hercules, Kenvil, N. J.	2	174
	2	98
Professional Fire Officer, Personal Experiences of	4	315

Q

Quilt and Pad Co. Fire, New Haven (Conn.). *Robert S. Moulton*	4	357

R

Rail Car Holocaust	2	142
Railroad Shop Fire, Pittsburg, Kansas	3	219
Reports, The 1941 Advance. *Editorial*	4	293
Rooming Houses, Fire Record of	3	257
R. R. Signal Tower Fire, St. Louis, Mo.	2	144
Rubber, synthetic, Hazards of	1	6

S

"S" Type Fuses	4	344
Sabotage. *Editorial*	1	5
Sabotage:		
Arson in Times of War. *Dr. Richard C. Steinmetz*	1	34
Through Fire. *E. P. Coffey*	3	214
San Francisco's World's Fair Fire. *Thomas McCaughern*	2	179
Seasonal Hotels, Fire Record of	3	256
Sprinkler Protection:		
in Airplane Hangars	4	367
in Hotels and Apartments	3	277
for War Incendiarism	4	313
St. Louis R. R. Signal Tower Fire	2	144

T

Tenements, Fire Record of	3	237
Terms, Glossary of British Fire	4	327
Theatre Tragedy, Brockton (Mass.). *Warren Y. Kimball*	4	348
Toronto Meeting, The. *Editorial*	4	293
Total Fire—The Incendiary Bomb. *John A. West, Jr.*	2	102
Type "S" Fuses	4	344

W

War Incendiarism:		
Arson in Times of War	1	34
Out of the Blackout	4	302
Sprinkler Protection Against	4	313
Total Fire	2	102
Warehouse Fires:		
New Orleans, La.	4	352
Owen Sound, Ont.	3	225
World's Fair Fire, San Francisco's. *Thomas McCaughern*	2	179

NOTE: This index does not include the Proceedings printed as Part 2 of the July, 1940, QUARTERLY, the Membership Directory printed as Part 2 of the October, 1940, QUARTERLY, nor the 1941 Advance Reports printed as Part 2 of the April, 1941, QUARTERLY.

A·D·T

Performance

1940

THE efficiency of A.D.T. Protection Services is not a matter of conjecture. Their effectiveness in minimizing fire and burglary losses can be determined accurately by the same method of statistical analysis that is the basis of insurance underwriting. The following performance records of A.D.T. Protection Services during the year 1940, merit the most careful consideration of executives and representatives of insurance underwriters:

Sprinkler Supervisory and Waterflow Alarm Service

Supervisory alarms, indicating impairment of sprinkler systems **118,243**

Waterflow alarms, indicating fire conditions or serious leaks **2,098**

Percentage of fire and water damage losses to insurable values of protected properties **14/1,000ths of 1%**

During the past ten years, subscribers to A.D.T. Sprinkler Supervisory and Waterflow Alarm Service have enjoyed 99.98% IMMUNITY FROM FIRE AND WATER LOSSES.

Watchman Supervisory and Manual Fire Alarm Service

Investigations of failures of watchmen to signal on schedule **172,844**

The total number of signals supervised was approximately 300,000,000; hence, the watchman patrol efficiency was **99.94%**

Manual Fire Alarms handled **1,453**

Percentage of fire losses to insurable values . . . **27/1,000ths of 1%**

During the past ten years, subscribers to A.D.T. Watchman Supervisory and Manual Fire Alarm Service have enjoyed 99.97% IMMUNITY FROM FIRE AND WATER LOSSES.

Burglar and Holdup Alarm Services

Burglars captured as result of A.D.T. alarms **405**

Percentage of losses in attacks on A.D.T. protection to insurable values protected . . **9/1000ths of 1%**

During the past ten years, subscribers to A.D.T. Burglar and Holdup Alarm Services have enjoyed 99.98% IMMUNITY FROM BURGLARY LOSSES.

Controlled Companies of

AMERICAN DISTRICT TELEGRAPH COMPANY

155 Sixth Avenue • New York, N. Y.

CENTRAL STATIONS IN ALL PRINCIPAL CITIES

A·D·T

Electric Protection Services

AGAINST FIRE • BURGLARY • HOLDUP

A NATION-WIDE ORGANIZATION

CANADA INVITES YOU --

Why Not Go?

THE OCCASION
Your National Fire Protection Convention.

THE DATE
May 12 to 16, 1941.

THE HEADQUARTERS
The Royal York Hotel, Toronto, the largest hotel in the British Empire.

RATES
Singles $4; Doubles $7 — twin beds. All rooms equipped with Tub and Shower Bath and Radio.

RESERVATIONS
Please advise the Hotel Manager, J. Johnson, as soon as possible of your date of arrival and space required.

GREETINGS
You may be sure of a friendly Canadian welcome as our honored guest.

OVER THE BORDER
The Canadian Government does not require American visitors to have passports to enter Canada. For convenience in crossing the Border going back into the United States, every traveler should carry something to establish his identity. Such papers as an old passport, birth certificate, baptismal certificate, motor certificate, tax receipt, club membership cards, proof of ownership of car, letter from bank manager or responsible municipal officer, driver's license or any papers of similar type will be helpful. Naturalized citizens should carry their naturalization certificate.

THE

ROYAL YORK

TORONTO

A CANADIAN PACIFIC HOTEL

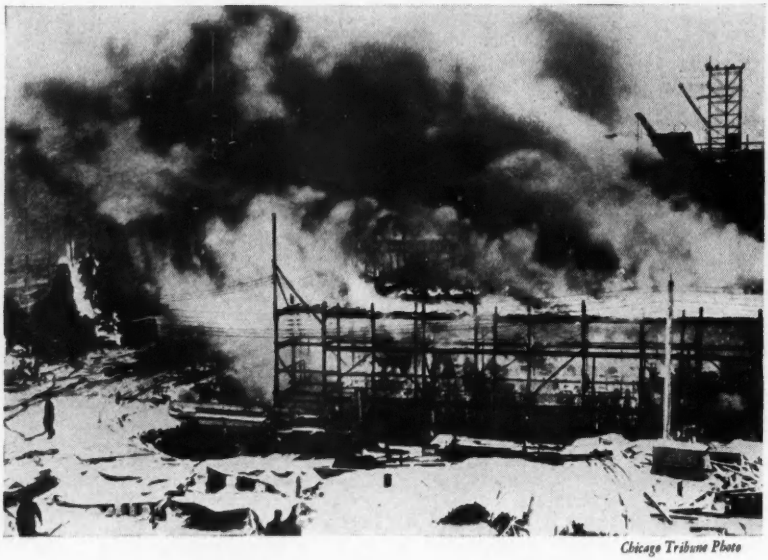
MINIMUM FILM RISK

EASTMAN Safety Films, available in all the emulsions recommended for regular clinical and dental radiography, are rated by underwriters as involving even less hazard than newsprint paper.

Eastman Kodak Company, Rochester, N. Y.

EASTMAN
SAFETY FILMS

$500,000 Loss Due To Flammable Canvas!



Chicago Tribune Photo

FIRE CHIEF Finished Duck would have prevented this needless building construction loss where an overturned salamander ignited a flammable canvas wind-break to cause a disastrous fire, entirely consuming 300,000 sq. ft. of canvas and the scaffolding, and seriously damaging the incompleted building.

Wherever unprotected canvas presents a fire hazard from hot coals, sparks, hot rivets, welding operations or workmen's torches, carelessly thrown cigarettes and matches — FIRE CHIEF Finished Duck assures new safety.

Approved by the Underwriters Laboratories and the Associated Factory Mutual Fire Insurance Companies, FIRE CHIEF also meets all Government requirements for a fire-, water-, weather- and mildew-resistant canvas.

WM. E. HOOPER & SONS CO.
New York PHILADELPHIA Chicago
Mills: WOODBERRY, BALTIMORE, MD.

FIRE CHIEF *The Finish That WON'T WASH OUT*

The ordinary wet pipe or dry pipe sprinkler system is a watchman, but the Suprotex Sprinkler System is a watchman with a watch dog to watch the watchman. In the Suprotex Sprinkler System:

1 It is the business of Rate-of-Rise Control — the Watchman — to detect any fire at the start, ring a fire alarm instantly, rush water to the sprinklers where it is held until there is enough heat for sprinkler discharge. Gives a chance to do things before a deluge of water goes to work.

2 It is the business of Automatic Supervision — the Watch Dog —

to sound a fire alarm gong—
if the Rate-of-Rise Control is put out of order.

to sound a trouble siren—
if pipes, fittings or sprinklers are damaged or tampered with. Such damage can be repaired without shutting off the protection or disturbing the fire alarm signal.

if the main control gate valve in the water supply is partially or completely closed.

if the water supply ahead of the main control valve is shut off.

To get the complete story of Suprotex for ordinary hazards, ask for Bulletin 48. For extra hazards, ask for Suprotex-Deluge Bulletin 44. Also General Catalog 49.

"AUTOMATIC" SPRINKLER CORP. OF AMERICA

YOUNGSTOWN, OHIO • *Offices in Principal Cities*

FIRE SAFEGUARDS

FOR every action there is a reaction, for every hazard a safeguard. Fire hazards, whether on foot, on wings, or on wheels, must be guarded against to avoid destruction.

The arsonist we leave to the police and fire marshals. Ground crews, fighter planes and balloon barrages attempt to control the fire demons on wings.

Fire hazards on wheels have been greatly minimized by state laws and city ordinances requiring internal safety valves in each compartment of a truck tank.

Our book "Transporting Inflammable Liquids With Safety," explains and illustrates the hazards of petroleum transportation and proper safeguards. Write for a copy—it's free to any fire authority.

We also manufacture a complete line of fire safety devices for refinery storage and bulk storage of petroleum products. Many of these devices carry the Underwriters' label. Complete information gladly furnished.

SHAND & JURS CO.
BERKELEY, CALIFORNIA
NEW YORK CHICAGO HOUSTON LOS ANGELES

SHAND & JURS

FAVORITE with Firemen

NONINFLAMMABLE
PYRANOL
TRANSFORMERS

SAFETY WITH SAVINGS
Pyranol transformer installed indoors on overhead platform. No vault was needed.

FIREFIGHTERS feel a lot more friendly toward transformers filled with Pyranol—General Electric's noninflammable synthetic cooling liquid for electric equipment. They know these transformers can't add to fire hazards—even if their tanks are ruptured—because PYRANOL CAN'T BURN!

Pyranol transformers can be safely installed right inside your building, *without a fireproof vault.* And the resultant savings in materials often make such installations the most economical as well as the safest.

Find out about noninflammable Pyranol. It provides the low-cost way to put transformers wherever you want them—*with complete fireproof safety.* Call our local office for additional details—or write for Bulletin GEA-2637. General Electric, Schenectady, N. Y.

GENERAL ELECTRIC

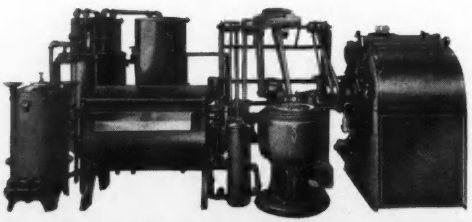
402-33-5100

While we are at all times interested in promoting greater safety in the use of the equipment we sell to the dry cleaning industry we are especially proud of this new development. Here for the first time is a petroleum solvent dry cleaning unit which has been granted listing by the Underwriters' Laboratories, Inc., under their Reexamination Service.

Such listing of course assures fire authorities and insurance rate-making bureaus that 140-F units will be built to specified standards and will be properly inspected.

USES 140° FLASH PETROLEUM SOLVENT

The Hoffman 140F dry cleaning unit employs a new solvent with flash point of approximately 140° F. The unit has many unusual features, including a drying tumbler with temperature automatically controlled throughout the drying cycle.



U. S. HOFFMAN MACHINERY CORPORATION
105 Fourth Ave. · New York, N.Y.
EQUIPMENT FOR EVERY DEPARTMENT OF THE DRY CLEANING PLANT

FIRE! FIRE!

With shrieking sirens, engines roar down the near-empty streets. As firemen work frantically to attach hose to hydrants, billows of flame and smoke pour out of the building. The next morning's headlines carry the all-too-familiar story:

LOCAL PLANT RAZED IN NIGHT BLAZE
LOSS PUT AT $150,000

Why?

If there was a watchman on the premises, why wasn't he alert? Why did he not detect the small blaze and extinguish it before it grew into a roaring inferno?

Perhaps the only answer is to ask another question: Was the watchman himself properly checked by an approved supervisory system?

A DETEX WATCHCLOCK SYSTEM gives an unalterable, tamper-proof record of your watchman's activities throughout the night—assures you that he's on the job. The cost is small and is usually paid for by lowered insurance rates.

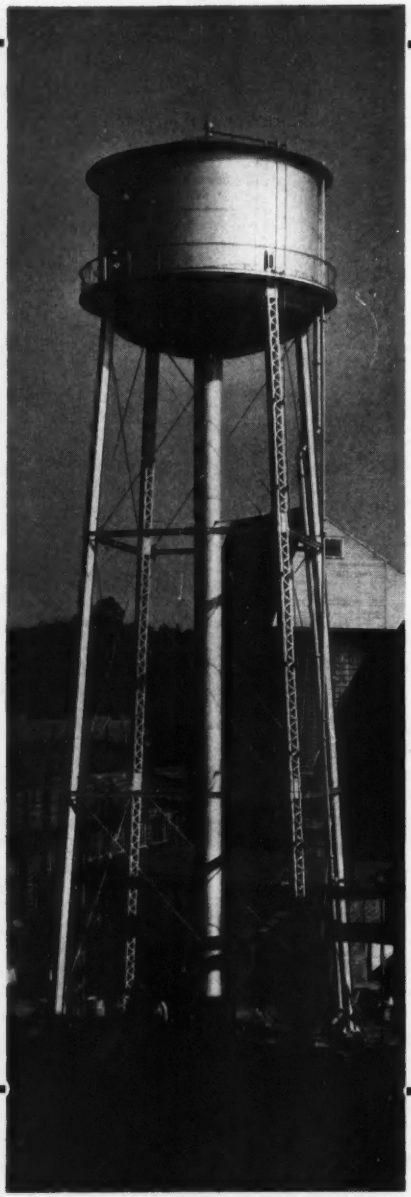
Have you DETEX protection in your plant?

DETEX WATCHCLOCK CORPORATION

84 Varick St., New York; 4163 Ravenswood Ave., Chicago; 31 Beach St., Boston; 802, 122 Marietta St., Atlanta

DETEX WATCHMENS CLOCKS

NEWMAN • ECO • ALERT • PATROL



FIRE PROTECTION FOR A PAPER COMPANY

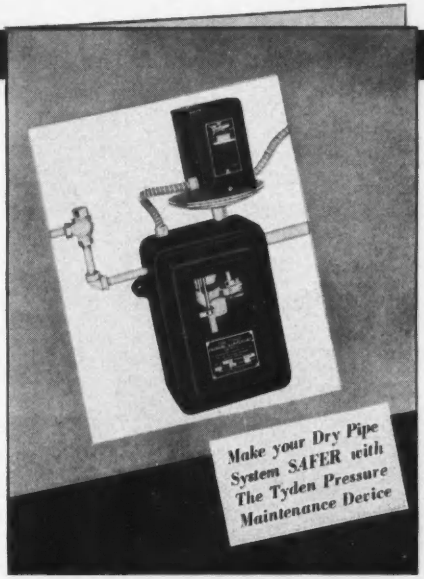
At an Eastern paper company the officials realize the advantages of automatic, dependable fire protection. Recently this 60,000-gal. elevated tank was installed to provide water by gravity pressure to the sprinkler system in their plant, and also to provide water for general use.

Elevated tanks connected to sprinkler systems in buildings, or to hydrants in yards or isolated spots give your plant the benefit of continual vigilance against fire. They are always on duty, no matter what the time of day or night. Their action is instantaneous and does not depend on personal responsibility or mechanical devices. It takes very little water to quench a fire that is just starting. That is why the quick action of gravity water pressure means so much.

Write our nearest office for further information and prices on all types and sizes of elevated tanks.

CHICAGO BRIDGE & IRON COMPANY

CLEVELAND CHICAGO BIRMINGHAM
DETROIT BOSTON LOS ANGELES
HOUSTON DALLAS PHILADELPHIA
NEW YORK TULSA SAN FRANCISCO



Your copy of this bulletin will be sent on request.

TYDEN PRESSURE MAINTENANCE

. . . an AUTOMATIC device that POSITIVELY maintains PROPER air pressure in the sprinkler system

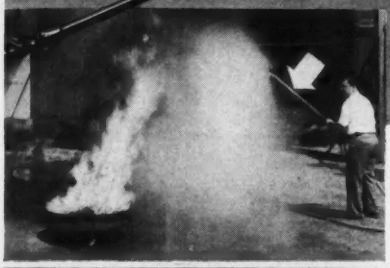
ACCEPTED by insurance underwriters, this TYDEN device is the *only* one available today that maintains positively at all times the proper amount of air pressure in dry pipe sprinkler systems. High air pressure is not only undesirable but is extremely detrimental to the operation of the system . . . the TYDEN Pressure Maintenance Device receives air from any constant source at any pressure higher than maximum required, and automatically delivers and maintains the proper pressure in the sprinkler system. Eliminates possibility of human or mechanical errors. Minimizes claims for fire or water damage. Pays for itself many times in maintenance costs. Talk it over with your VIKING man.

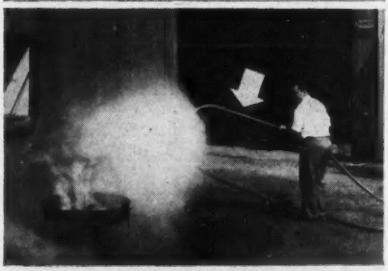
Representatives in Principal Cities

THE VIKING CORPORATION

HASTINGS, MICHIGAN—U.S.A.

NEW WEAPON *puts out* FLAMMABLE LIQUID FIRES





Low velocity WATERFOG quickly extinguishes a gasoline fire.

Fire in such flammable liquids as fuel oil, kerosene, mineral spirits and even gasoline in open tanks can be quickly subdued by WATERFOG discharged from this Rockwood Applicator.

Just connect the Applicator to a hose line, turn on the water and you produce WATERFOG — an amazing new fire extinguishing agent. WATERFOG is extremely economical, clean and practically inexhaustible in its supply.

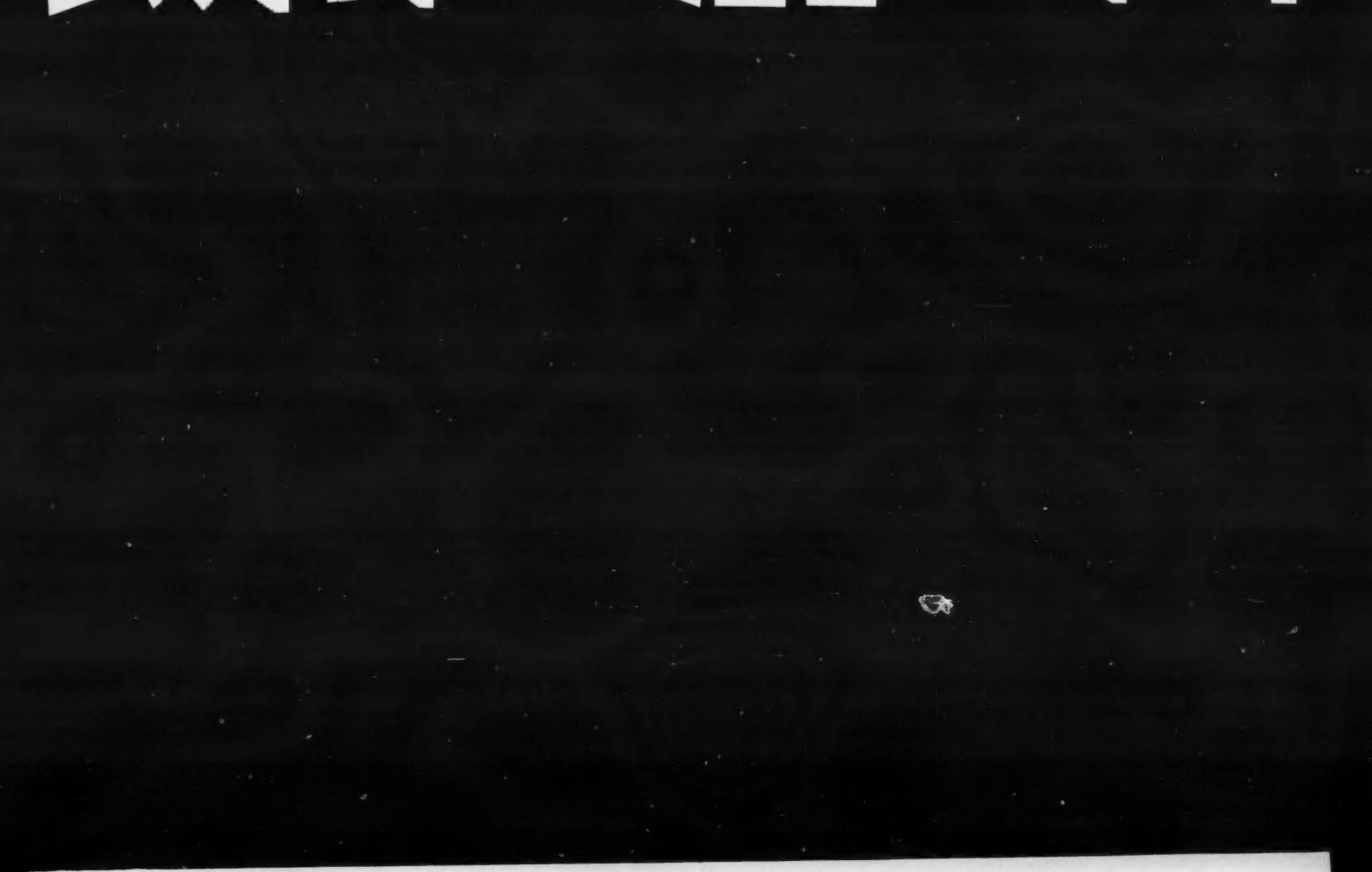
The Rockwood WATERFOG Applicator is an excellent all around fire fighting weapon for industrial or municipal fire departments. WATERFOG Fire Protection Systems in the form of fixed piping installations are also available for the protection of dip tanks, quenching tanks, oil storage, transformers, oil circuit breakers, regulators, dryers and many other types of hazards involving flammable liquids or materials. Write for our new descriptive booklet.

ROCKWOOD SPRINKLER COMPANY

Sprinkler Systems and Fire Protection Engineering

WORCESTER, MASSACHUSETTS

In Canada: Worcester Fire Extinguisher Co., Ltd., Montreal and Toronto



GAMEWELL

Fire Alarm Watch, and Plant Supervisory Systems

for

Government, Industrial, Railroad and Institutional Properties

Fire interrupts the continuity of business and is reflected in the loss of intangible values far greater than the replaceable physical values destroyed. Delays in the discovery and announcement of Fire and Crime . . . the principal causes of large losses and consequent interruptions of operations . . . are minimized by Gamewell signaling systems.

INDUSTRIAL PROPERTIES

such as the following rely upon Gamewell systems for emergency signaling.

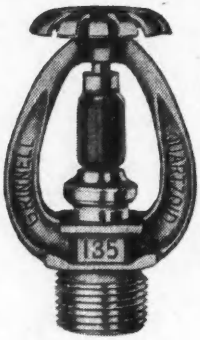
BELL TELEPHONE SYSTEM	250 properties
GENERAL ELECTRIC COMPANY	13 plants
WESTINGHOUSE ELECTRIC & MFG. CO.	5 "
INTERNATIONAL HARVESTER CO.	8 "
FORD MOTOR CAR CO.	9 "
DuPONT DE NEMOURS & CO.	32 "
PULLMAN CAR & FOUNDRY CO.	7 "

There is a reason why. Write for complete information.

THE GAMEWELL COMPANY

NEWTON UPPER FALLS

MASSACHUSETTS



On The Firing Line!

America's National Defense Program is rapidly taking shape. Mills and factories are humming. Industry, in a combined effort to fulfill government and private contracts, is on the firing line. Speed, WITHOUT INTERRUPTION is vital.

Grinnell Automatic Sprinklers are on the firing line too — have been for over half a century. Today they are standing guard over many industries engaged in this great Program — standing guard to prevent any interruption by FIRE!

Ever changing manufacturing methods and processes — greater concentrations of equipment and materials — speed in production — all of these multiply the possibilities of fire. Yet there is a type of Grinnell Sprinkler System for every fire hazard. Each is designed to provide the utmost in adequate fire protection for specific conditions. Complete information is available for the asking from any of our offices throughout the country. Grinnell Company, Inc., Executive Office, Providence R. I.

GRINNELL

AUTOMATIC SPRINKLER FIRE PROTECTION